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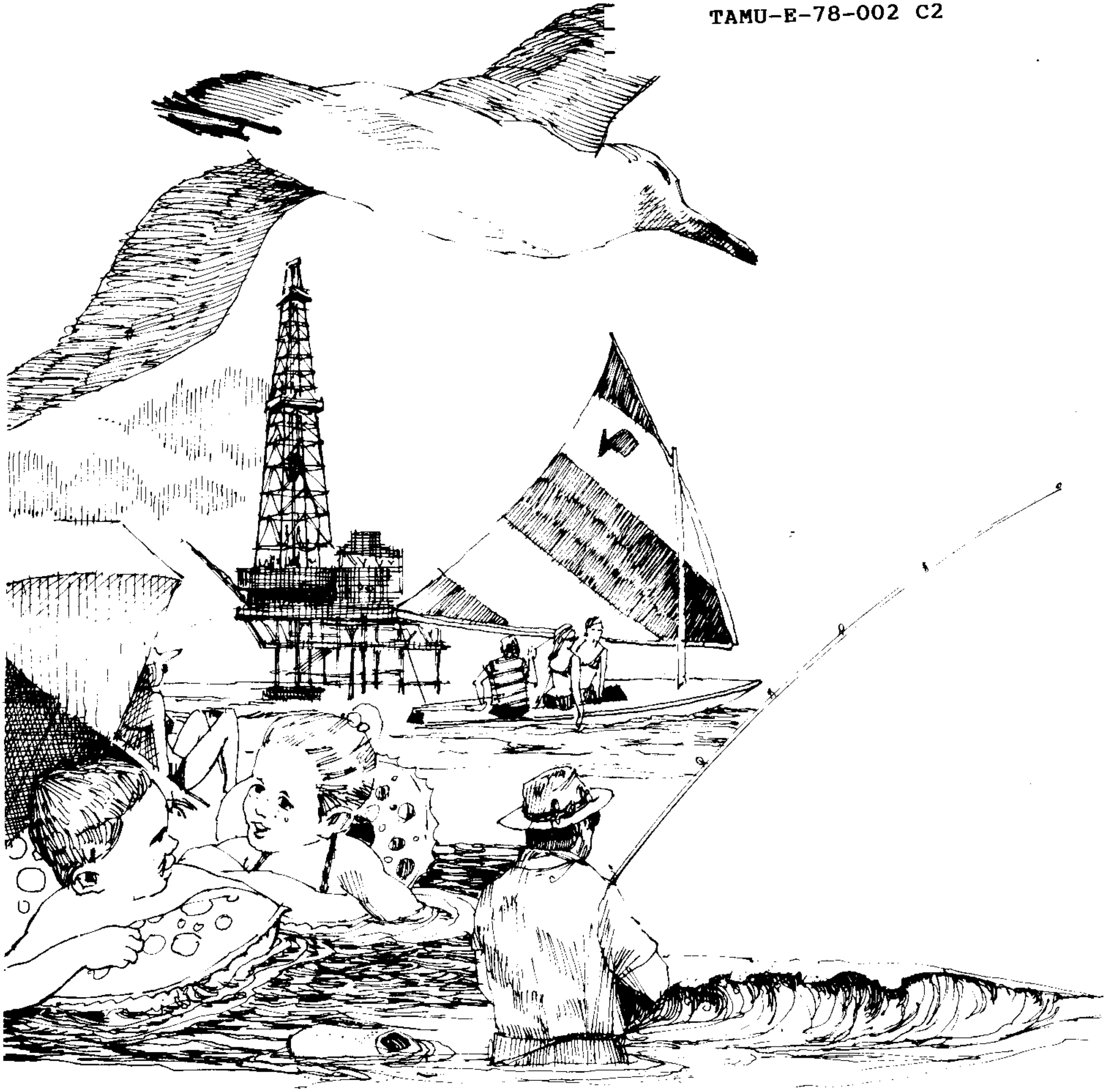

Investigating the Marine Environment and Its Resources

PART I

TAMU-SG-79-401

INVESTIGATING THE MARINE ENVIRONMENT AND ITS RESOURCES

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Delmar Janke
Project Leader

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INVESTIGATING THE MARINE ENVIRONMENT AND ITS RESOURCES

The purpose of this resource unit is to provide activities which will assist students in becoming knowledgable about the marine environment and its resources. They will become aware of the intricate interrelationships (biological, physical, chemical) within the marine environment. The students will also consider man's interaction with the marine environment and its resources--past, present and possible future. They will analyze their lifestyles and the influence of the marine environment and the way they use the marine resources upon it.

It is hoped that they will become aware of the things which they must consider to live, in as much as is possible, in harmony with nature.

As they see how their lifestyle is dependent, among other things, upon the marine environment and its resources, they might be moved to consider more carefully their treatment of that environment and its resources.

Whether it is the water of the global sea or the fresh water of the land, our lives and fortunes depend on it. This has always been true. However, we have based our progress and expansion on the false assumption that the bounty of the land and water are endless, and as though the rivers, estuaries, and seas could absorb without harm an infinite amount of wastes. Now, a combination of growth, demand and pollution is pushing us toward our fresh water limits, and the depletion of some land resources forces us to turn again to the seas. The increase in population and the movement of people toward our saltwater shores places enormous pressures on the fragile coastal zones and adjacent waters while growing industrial use creates further pressure and sometimes conflict. A reawakening to the importance of our marine waters is late, but not too late if we understand and support careful, planned use of our oceanic resources.

In the resource unit, it is our desire to do more than make students aware that something must be done. We hope that they will develop a basic understanding of the marine components as a part of the whole environment, and their importance to American life and society. We also hope to create an awareness of and sense of responsibility for water--to develop a "water ethic" embracing the proper uses, protection, and conservation of the oceans and the coastal zone. Also to motivate students to take part in decisions affecting the sea while equiping them with principles and information necessary to evaluate problems, opportunities and events. Achieving this would result in their becoming more "literate" in marine affairs.

"The oceans will offer us military, recreational, economic, artistic, and intellectual outlets of unlimited scope. Thus they'll offer us more space itself in which to remain human. The sea--beautiful and dangerous, elegant and strong, bountiful and whimsical--not only challenges us but offers to every 'man in the street' the exciting participation of being a 'man in the sea.'"

Athelstan Spilhaus, father
of the Sea Grant concept.

RESOURCE UNIT--TEACHING UNIT

This document, being a resource unit, contains many more activities than a teacher would include in a teaching unit related to marine resources. It is the responsibility of the teacher to determine the objectives of her/his teaching unit and to then select teaching/learning activities which are designed to accomplish those objectives.

For the field of testing of this unit a teaching unit was designed which included a sample of the activities in this resource unit. That teaching unit guide is included as Appendix A of this document. It is intended that this sample teaching unit might serve as inspiration for you to develop whatever type of a marine resource unit which will satisfy your and your students' needs. Obviously, teachers of science, social studies, history, reading, music, etc,. will design differing units. It is hoped that there are enough different activities in this resource unit to meet the needs of many different kinds of teachers and students.

GOALS AND MAJOR OBJECTIVES FOR THE UNIT

GOAL 1: TO DEVELOP AN UNDERSTANDING OF THE INTRICATE INTER-RELATIONSHIPS WITHIN AND AMONG ALL PARTS OF THE TOTAL ENVIRONMENT WITH EMPHASIS ON THE MARINE ENVIRONMENT AND RESOURCES.

1. Understand basic marine and environmental terms.

2. Recognize that in spite of great diversity in types of actual ecosystems there are certain general structural and functional attributes and the ecological relationships do not exist in a vacuum but in a physical-chemical setting.

3. Understand that ecological relationships are basically energy and nutrient relationships with sunlight as the basic source--usable energy decreases as we progress through the food chain or web while the amounts of nutrients are not diminished.

4. Conclude that all living things came originally from non-living material and also that the elements of which living things are made are basically the same as those of non-living materials and these elements move in cycles and are recycled.

5. Recognize that the abundance of water makers the earth unique in our solar system and that the oceans interact with the earth and its atmosphere.

GOAL 2: TO ANALYZE THE EFFECTS OF MAN'S PAST ACTIVITIES UPON THE MARINE ENVIRONMENT AND RESOURCES AND ANALYZE POSSIBLE FUTURE RESPONSES OF MAN'S INTERACTION WITH THE MARINE ENVIRONMENT AND RESOURCES AND CONSIDER HOW TO FORESEE AND AVOID UNDESIRABLE CONSEQUENCES.

1. Comprehend that man can and does affect the process of energy flow and nutrient cycling.

2. Conclude that the environment of any locality will change with the passage of time.

3. Recognize that environmental problems do not have simple answers; that problems have existed, exist, and will exist and many factors must be considered (e.g., ecological, social, economic, governmental, psychological, and moral).

4. Evaluate the needs and wants of organisms and man in an environment and recognize that the needs and wants change.

5. Recognize marine resources and the consumer products in terms of their resource origins.

6. Understand that resource use is determined by the needs and values of individuals and troups which may change with time and are influenced by cultural, social, economic, and political factors.

7. Recognize the important influence which the marine environment has had and will continue to have upon the lives of people and upon the destiny of nations.

GOAL 3: BECOME MORE SKILLFUL WITH REGARD TO THE TECHNIQUES OF GOOD MANAGEMENT, PLANNING, AND PROBLEM SOLVING WITH RESPECT TO THE MARINE ENVIRONMENT AND RESOURECE NOW AND IN THE FUTURE.

1. Recognize that the quality of the marine environment will be in part a reflection of man's capacity to manage it; that problems have existed, exist, and will exist and that it will require much more understanding of many factors (e.g., ecological, social economic, governmental, psychological, and moral).

2. Analyze the role of technology in the use of resources--past, present, and future.

3. Analyze what considerations are important in the processes of acquisition of marine resources.

4. Understand the importance of future planning of the use of marine resources.

GOAL 4: DEVELOP A GREATER APPRECIATION OF THE MARINE ENVIRONMENT AND RESOURCES.

1. Comprehend that man's perception of the marine environment may be either positive or negative depending on social, economic, or other factors.

2. Choose to interact with the environment in non-consumptive manners.

3. Become aware of his relationship with the marine environment and resources.

LESSON ONE

ACTIVITY ONE-Earth is a Water Planet
ACTIVITY TWO-Words, Poems and Books of the Sea

Suggested Time for Classroom Use of Materials: Approximately 3 to 5 class periods

Materials for Classroom Use:

Captain Al G. Seaborne/sketch
Writing a Syntu/information sheet
The Sea and Me/information sheet
Brainstorm/information sheet
Slide series "Earth is a Water Planet"
Collage of Concerns and Feelings
Marine Words/reading
Poetry of the Sea/information sheet
Magazines
Newspapers
Glue, scissors
Coloring and writing materials
Posterboard, newsprint or construction paper

Major Objectives for the Lesson: After completing the activities the student will be able to:

1.1 list and define new terms;

1.1 define and describe a marine environment;

1.5 conclude that planet earth is uniques due to the abundance of water;

1.5 discuss the unique physical and chemical properties of water;

2.5 point out some marine resources;

2.7 conclude that Texas is a marine state;

2.7 identify ways the sea (marine environment) has influenced man and his heritage;

3.1 discuss man's use and management of the marine environment;

4.1 evaluate his feelings and concerns about the marine environment;

4.1 attempt to express his concerns about the marine enviroment;

4.1 share his feelings about the sea with his classmates.

Analyze poems and books of the sea.

Teaching Suggestions: The purpose of this activity is to introduce the topic of the unit to the students. The students will also evaluate their feelings about the marine environment. A slide/audio tape series having "Captain Al G. Seaborne" as the main character will introduce the concept of "Earth as a Water Planet".

1. Give a pretest if you choose to use one.

2. Make some introductory statements about the unit if you have not already done so at a previous time. Introduce Captain Seaborne.

3. Have the students write the syntu and The Sea and Me activity. Have the students share and discuss their syntus and their responses in The Sea and Me.

4. Brainstorming can be done as a whole class or in small groups. It seems to work best in groups of 7-12. If you use small groups plan for a report.

5. Show the slides/audio tape. Time: approx. 15 minutes.

6. Discuss any points which the students wish to discuss.

7. You may have the students do Collage of Concerns and Feelings individually, in small groups or as a class.

8. Have the students read Marine Words and make plans as to how the students/class will keep a record of the new words they will be learning in this unit.

9. Start a list of marine environment and marine resource words. Put them on a large chart. Have the students learn how to pronounce each word and be ready to tell its meaning. Add to the list as new words are learned. Allow a few minutes each day or so at the end of the class period for the students to add new words to the list.

10. Start a class marine environment and resource dictionary. Use a loose-leaf notebook with one sheet for each word. Write the word and its meaning. Cut out a picture from a magazine or make a drawing to help show what each word means. Keep adding to the dictionary as new words are learned. Students may take turns preparing the pages.

11. You may have the students go the the library and find their own poem or you may bring books to class. (Your English and Literature teachers can help you. Good opportunity to involve teachers from other disciplines or community resource people who may have special knowledge of Literature of the Sea.)

12. In the optional activity of identifying marine works in your school or local public library, you may wish to assign a small group of students to an area. The class may compile an annotated bibliography which can be used throughout the unit.

Introduction
Earth is a Water Planet

LESSON ONE

ACTIVITY ONE

Write or
Complete -

A syntu about the sea.
The Sea and Me

Share -

Your syntu and your responses to "The Sea and Me" with your classmates.

Brainstorm
and list -

All the ways you can think of that water or the marine envrionment has influenced man.

Share -

Your lists with your classmates.

Listen to
and view -

Audio tape and slides on "Earth is a Water Planet".

Think -

About your concerns and feelings about the ocean.

Make -

A collage of your concerns and feelings about the ocean.

Optional
Select -

A way that the sea affects man and report on it to your class by means of a story, play, music, song, drawing, painting, dance, model and etc.

WRITING A SYNTU/INFORMATION SHEET

Write a syntu about the sea or the marine environment. A syntu is a Japanese poem consisting of five lines. The lines are as follows:

<u>In line 1</u> use one word--the name of a marine animal, object, event or phenomenon.

<u>In line 2</u> write an observation of the item you named in line 1 using one of the five senses.

<u>In line 3</u> write a feeling about the item named in line 1.

<u>In line 4</u> write another observation of line 1 using one of the senses not used in line 2.

<u>In line 5</u> write a one-word synonym for line 1.

Write your syntu below!

THE SEA AND ME

Complete the following sentences:

What I like most about the sea is

What I like least about the sea is

When I hear the word sea, I think of

When I hear the word sea, I feel

The most worthless part of the sea is

The most priceless part of the sea is

The most meaningful part of the sea is

BRAINSTORM/INFORMATION SHEET

Purpose: To make a list of all the ways you can think of that water or marine environment has influenced man.

1. Divide into groups.
2. Choose a chairperson, one who keeps the ball rolling.
3. Select recorder(s) to write down every idea suggested. Record fast, keep ideas flowing.
4. Select a time keeper. Someone to keep track of the time for the group.
5. Time limit of 5 minutes.
6. All ideas welcomed. Nothing has to be explained. Expand on other's ideas. Help each other. Listen. Others may trigger something in your mind, and you may trigger their's.
7. Work to get as many ideas as possible. See which group gets the longest list.
8. Goal: To make a list of all the ways you can think of that water or the marine environment has influenced man.
9. Share your lists.

VIEW SLIDES ON "EARTH IS A WATER PLANET"

Add to your list of all the ways you can think of that water or the marine environment has influenced man; as you learn from each other and the slides and tape.

EARTH IS A WATER PLANET

Slide 1:
Background music

Slide 2:
Background music

Slide 3:
Background music

Slide 4:
Greetings mates! I'm Captain Al G. Seaborne. I have sailed all kinds of vessels all over the world. However, I call the Gulf coast my home. Thank you for inviting me to speak to you on one of my favorite topics--the influence of water on us.

Slide 5:
The Apollo moon missions gave us for the first time in human history a picture of our home--planet earth. When the astronauts looked at the earth, they called it, "the Blue Planet". What do you think makes the earth appear blue? You are exactly right--water. Our earth is a world of blue water partly concealed by patterns of white vapor clouds that mark the movement of the weather systems.

Slide 6:
The brown and green shapes are the land masses or continents. Which do you think covers more area--land or water? If you said water, you are correct. The oceans cover nearly 71% or almost three-fourths of the earth's surface. So our continents are actually islands in the global sea.

Slide 7:
Life on this earth is water based! As we examine all the different life forms on earth, we find that some withstand great temperature extremes and some even live without oxygen. However, all rely on water for survival. In fact did you know that your body is about 60 to 70 percent water? That means that you are also a water creature.

Slide 8:
Water runs throughout our bodies as it does throughout the earth. On earth like in our bodies, water acts as a solvent and a transport system to remove poisons and wastes.

Slide 9:
Water is our most common solvent. It dissolves more substances than any other solvent. In sea water there are up to fifty-seven elements present including common table salt, zinc, gold, and silver. Since the solvent power is so great, it is rare to find truly "pure" water anywhere in nature.

Slide 10:
Another result of water's solvent power are the caverns, valleys, canyons and deltas on the face of this planet. Therefore we can say that water has actually helped give the earth its face.

Slide 11:
Even though water is an excellent solvent, it is easy to obtain water in a fairly pure state. Thus, we can use water as a scientific standard in many ways. For example, we use it as a standard to determine calorie, BTU and specific gravity. We also use it for graduating thermometers since the temperature at which water freezes and boils is the freezing and boiling point on a thermometer. So you see, water is really important--isn't it?

Slide 12:
Ever wonder what life would be like without water? With no oceans the earth would be intolerably hot during the day and miserably cold at night. Water modifies our climate by storing heat and redistributing it over the earth through ocean currents and atmospheric circulation. The sea is also the source of extraordinary climatic events such as hurricanes and tropical storms.

Slide 13:
Do you know that our language in spite of its remarkable range and flexibility does not have a common-use noun or adjective to embrace the entire world of water from salt to fresh, from vapor to ice? However the global sea is the planet's dominant feature. The Latin word for sea is mare, the source of our adjective marine. The common characteristic of all things marine is saltiness. Consequently the marine environment is that environment which contains or is directly influenced by salty water. It also refers to the many ways in which water influences and affects our lives and the life and environment of all living things.

Slide 14:
Water draws us, capturing our attention and our imagination. From prehistoric times to the present, the sea has been an important theme in art, literature and song throught out time. It has been as inspiration for ballads, shanties, songs, symphonies and operas. The sea and its rhythmical movement has also inspired choreographers.

Slide 15:
Many terms and expressions of the sea have become part of our language today. A few of these are average, A-1, first rate, taken aback, clean bill of health, out of commission, laid up, junk, on the rocks, freight, crew, overhaul, cranky and the bitter end.

Slide 16:
The sea has influences on our architecture too.

Slide 17:
In countless ways, large and small, the resources of the sea touch our lives from the pudding in today's snap pack to the foam on

beer to oil and gas in our automobiles. How many marine resources do you use directly or indirectly? More than you think!

Slide 18:
Initially a major resource of the ocean was transportation. It is equally valuable today. Of our 50 states only 10 do not have contact with the sea directly or indirectly because of inland waterways.

Slide 19:
More and more we are turningto the sea as a source of energy. Energy from the sea has taken many forms and will take more in the future.

Slide 20:
One of the phenomena of our time is the tremendous increase in marine recreation. How many recreational activities can you list?

Slide 21:
We can see history as the movement of peoples and nations in response to the presence or absence of water. Our country has always been a maritime nation and even our major population centers are near water. Do you know that more than one half of our population lives only an hour's drive from the sea?

Slide 22:
We think of Texas as a land of ranches, cows, cowboys and oil wells. I'll bet you seldom think of Texas as a land of windswept beaches and soaring sea gulls.

Slide 23:
Texas ranks second in the United States in land area and third in length of coastline. Yes, the Texas shoreline is over 1000 miles long.

Slide 24:
Do you know that there are fourteen major deep water ports located along the Texas coastline? The Port of Houston is the largest inland port and ships to 250 major world ports. Galveston is the world's largest cotton port.

Slide 25:
The port of New Orleans of the Gulf of Mexico is the second largest port in the United States while Corpus Christi is the nineth largest.

Slide 26:
In Texas each of these ports is the location for petroleum refineries, bulk terminals and petrochemical plants. I'll bet you didn't know that this region contains more than 50 percent of the nation's petrochemical industry and 25% of its refinery capacity.

Slide 27:
Do you realize that this area is also the major spawning and

nursery area for more than seventy % of the fish and shellfish population in the Gulf?

Slide 28:
Because we traditionally think of Texas as cattle country, it is difficult to realize that Texas is one of the nation's foremost producers of marine fishery products. More than 200 million pounds of fish and shellfish are landed annually on the Texas coast.

Slide 29:
Not long ago our view of the sea was filled with myths and legends. Attitudes and viewpoints have changed. The horrors of the deep have become the shy creatures of Jacques Cousteau's films. We had songs about the whale and now, we have recorded the song of the whale itself.

Slide 30:
The most profound change in our perception of the sea is that we now know that the ocean floor is not uniform, motionless or featureless. Instead it has mountains, plains, canyons and the continents are drifting apart. The history of the earth is not what it seemed.

Slide 31:
The marine environment influences us but the balance is changing. How?, you ask. We have not fished the oceans clean, but we probably could. We have not poisoned them, but we probably could. We have not significantly altered the vast open ocean, but near the cities we have.

Slide 32:
Even the open ocean is defenseless against the pollution of some new materials created by man. We also face the ultimate pollution of nuclear wastes, not necessarily those from power plants. Do you realize that a twenty minute exchange of nuclear rockets could poison the oceans?

Slide 33:
How does water influence us and our lives? How is the influence changing? How do we influence the marine environment? How do we measure up? What must we do? These are things we need to learn more about in the future.

Slide 34:
Well mates, it's been nice visiting with you. I'm looking forward to sharing some things that I have learned about the marine environment with you in the activities that follow.

Slide 35:
The end.

COLLAGE OF CONCERNS AND FEELINGS

Think about the following:

What are your concerns about the ocean at the moment?

What in the ocean is important to you?

What are your feelings about the ocean?

What are your hopes and dreams for the ocean?

Now leaf through magazines and newspapers. Tear out titles, pictures, words, slogans, and want ads that portray your feelings, concerns and etc. about the marine environment. Then paste your tear-outs together on a sheet of newsprint and add color, design or graffiti with poster paints or magic markers.

Introduction
Words, Poems and Books of the Sea

LESSON ONE

ACTIVITY TWO

Read -

Marine words

List -

New words and meanings that you learn in this unit.

Read -

A poem about the sea.

Complete -

Sentences on Poetry of the Sea.

Share -

Poem you have read with your classmates.

<u>Optional</u>
List -

The marine references available in your school library.

Group -

The books as fiction, historical fiction, informational, biography, poetry.

<u>Optional</u>
Read -

One of the books from your list.

Write -

A report on the book.

Give -

An oral report on the book to your class.

MARINE WORDS

Words are created, flourish and fade away as their need disappears. A hundred years ago, the Nantucket whaler spent his free time doing scrimshaw work. Today the Nantucket whaler is gone. So there is little need for a word meaning etching on ivory.

Today there is a need for new words. A large number of people are discovering, inventing, and doing new things related to the ocean. The surfer and oceanographer need new words to describe the waves. The geologist needs new words to describe the sea floor. The lawyer needs new words to describe legal matters concerned with the sea. The oil company executive needs new words to order a platform for drilling oil in deep water.

Confusion may be expected when new words are created. People use them in different ways. There may be several new words to describe one thing. Of course, the meaning of the word may change. A word that is satisfactory for one purpose may be used for another purpose for which it does not fit. All these new words and concepts can lead to confusion. Nothing can be done about this. By the time the words are standardized and in dictionaries many of them are out of date.

To help us learn the new words and concepts and to avoid all the confusion, we will develop our own dictionary or word list.

POETRY OF THE SEA

Read a poem about the sea.

Name of poem ______________________________

It was written in (approx. year)______________________________

It says the sea is ______________________________

____

The writer's feelings about the sea are ______________________________

____

____

The poem makes me feel ______________________________

____

What did the sea mean to the writer? ______________________________

____

Would this poem be written the same today and in the future?

____

____

LESSON TWO
THE SHAPE OF IT!

ACTIVITY ONE-Trip into the Depths of the Gulf
ACTIVITY TWO-Mural of the Gulf's Floor

Suggested Time for Classroom Use of Materials: 1 to 3 class periods

Materials for Classroom Use:

Physiographic Provinces of the Gulf of Mexico/drawing
Trip into the Depths of the Gulf of Mexico/reading
Sketches of Continental Shelf, Slope, and Abyssal Plain, GOMUER Vessel
Cross section view of Gulf of Mexico/drawing
Chart of Characteristics of Floor of the Gulf
Mural of Gulf's floor

Major Objectives for the Lesson: After completing the activities the student will be able to:

1.5 identify the characteristic features of the ocean basins;

1.5 construct a model or diagram of a ocean floor.

Teaching Suggestions: The purpose of this lesson is to present information on the features of the floor of the ocean and to help the student to realize that the ocean floor is not featureless.

1. Have the students complete the reading, look at the drawings, respond to the questions, and complete the activities.

2. Have the students construct a mural on paper which can be placed on the wall. In later activities they will add to the mural.

3. Discuss how the floor of the Gulf of Mexico differs from the Pacific and Atlantic oceans. Encourage

students to read articles on the exploration and study of the ocean floor.

4. The following articles would be excellent for the students to read for additional information on the exploration and study of the ocean floor. They are all found in the National Geographic Magazine.

"Diving into the Blue Holes of the Bahamas"
Vol. 138, No. 3 (Sept. 1970) pp. 347-363
"Deepstar Explores the Ocean Floor"
Vol. 139, No. 1 (Jan. 1971) pp. 110-129
"Tektite II: Part One-Science's Window on the Sea"
Vol. 140, No. 2 (August 1971) pp. 256-289
"Tektite II: Part Two-All-girl Team Tests the Habitat"
Vol 140, No. 2 (August 1971) pp. 290-296
"Diving Beneath Artic Ice"
Vol. 144, No. 2 (August 1973_ pp. 248-267
"Project FAMOUS-Where the Earth Turns Inside Out"
Vol 147, No. 5 (May 1975) pp. 586-603
"Project FAMOUS-Dive into the Great Rift"
Vol. 147, No. 5 (May 1975) pp. 604-615
"Window on Earth's Interior"
Vol. 150, No. 2 (August 1976) pp. 228-249
"Oases of Life in the Cold Abyss"
Vol. 152, No. 4 (October 1977) pp. 441-453
"The Continental Shelf-Man's New Frontier"
Vol. 153, No. 4 (April 1978) pp. 495-529

THE SHAPE OF IT!
TRIP INTO THE DEPTHS OF THE GULF

LESSON TWO

ACTIVITY ONE

Look at -

Physiographic Provinces of the Gulf of Mexico

Read -

"Trip into the Depths of the Gulf of Mexico"

Imagine -

The features of the floor of the Gulf of Mexico.

Draw -

Picture to illustrate any part of "Trip into the Depth of the Gulf of Mexico".

Share -

Your drawings and impressions with your classmates.

Label -

Sketches of the continental shelf, slope and the abyssal plain.

Look at -

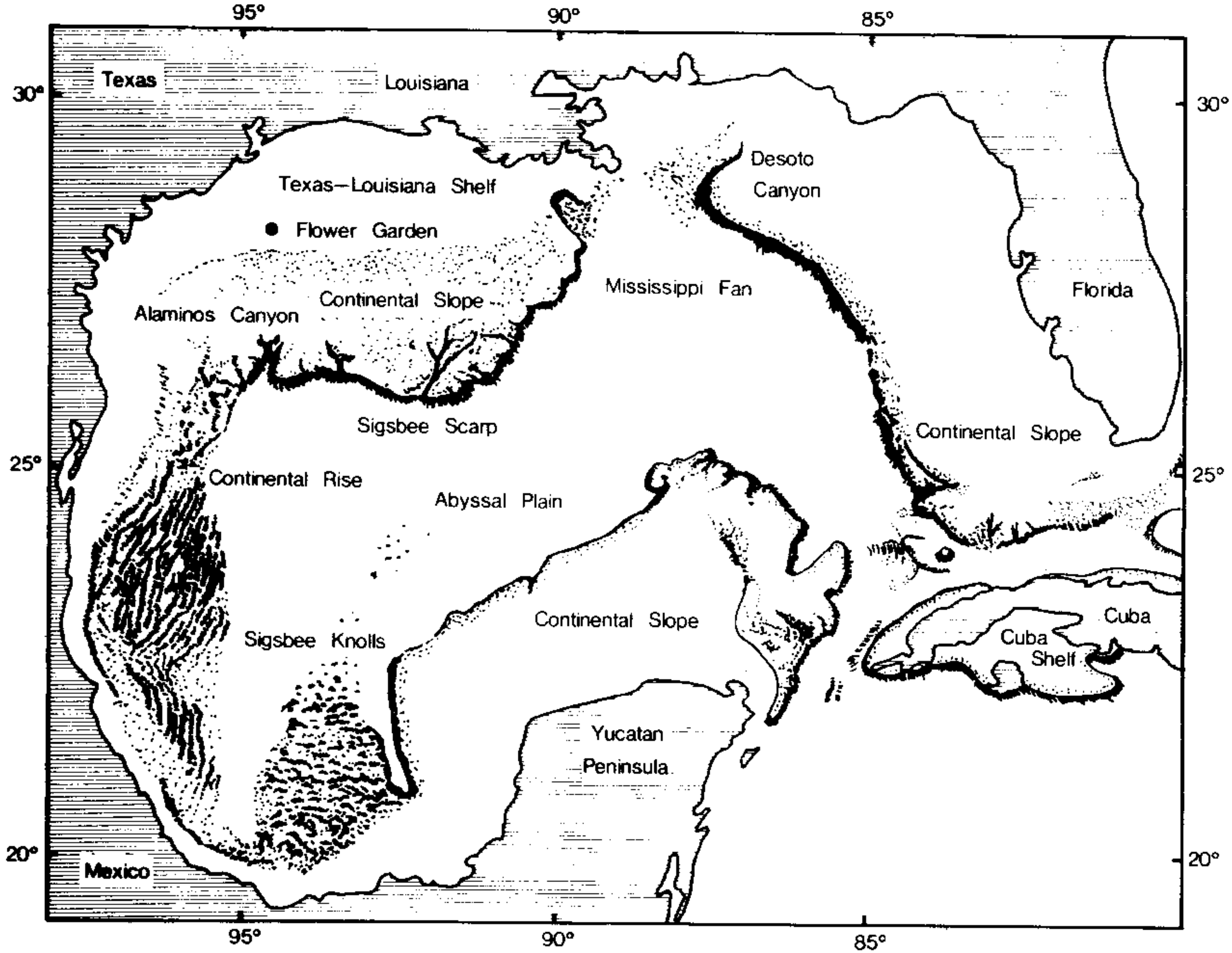
Cross section view of Gulf of Mexico

Complete Chart -

On characteristics of the ocean floor.

Answer -

Questions on Features of ocean floor.



Physiographic Provinces of the Gulf of Mexico

TRIP INTO THE DEPTHS OF THE GULF OF MEXICO

Put your head on your desk and close your eyes. This is Captain Seaborne. You and I are going to take a trip along the bottom of the Gulf of Mexico. You have been chosen to be the first young person to go into the depths of the Gulf. A black limosine pulls up in front of the school and a man in a blue suit comes to your room to get you. You are driven to Galveston. Two oceanauts or aquanuats meet you. You do not need any special clothes since the pressure, air, and temperature is regulated inside the passenger chamber. The aquanauts are trained to operate the minisub GOMUER (Gulf of Mexico Underwater Exploration and Research) which will take you into the depths of the ocean. You now enter the sphere in which passengers are housed. The sphere is the best shape for withstanding the extreme water pressure of the ocean depths. Your minisub is made of a new titanium alloy only 2 inches thick which has withstood water pressure at depths of 23,000 feet. You are looking out of thick, sperical, plexi-glass portholes.

Now all is ready for the trip. The doors to your chamber are locked. The signal is given to submerge and move away from the beach. As you leave the beach, the land below is the continental shelf. It slopes out from the beach. The depth of the water generally ranges from 0 to 600 feet with an average depth of 400 feet. The average width of this area is about 40 miles. Here in the Gulf, the width varies from 8 miles along the coast of Mexico to 117 miles along western Florida.

The area around us resembles the adjacent land so here in the Gulf the shelf is also rugged. Occasionally you see small hills. These small hills have algae reefs on top. They were formed a million years ago when the level of the water was lower. During the Ice Age when water was drawn up into glaciers the sea levels of the world dropped some 500 feet. So this was not under water during that time.

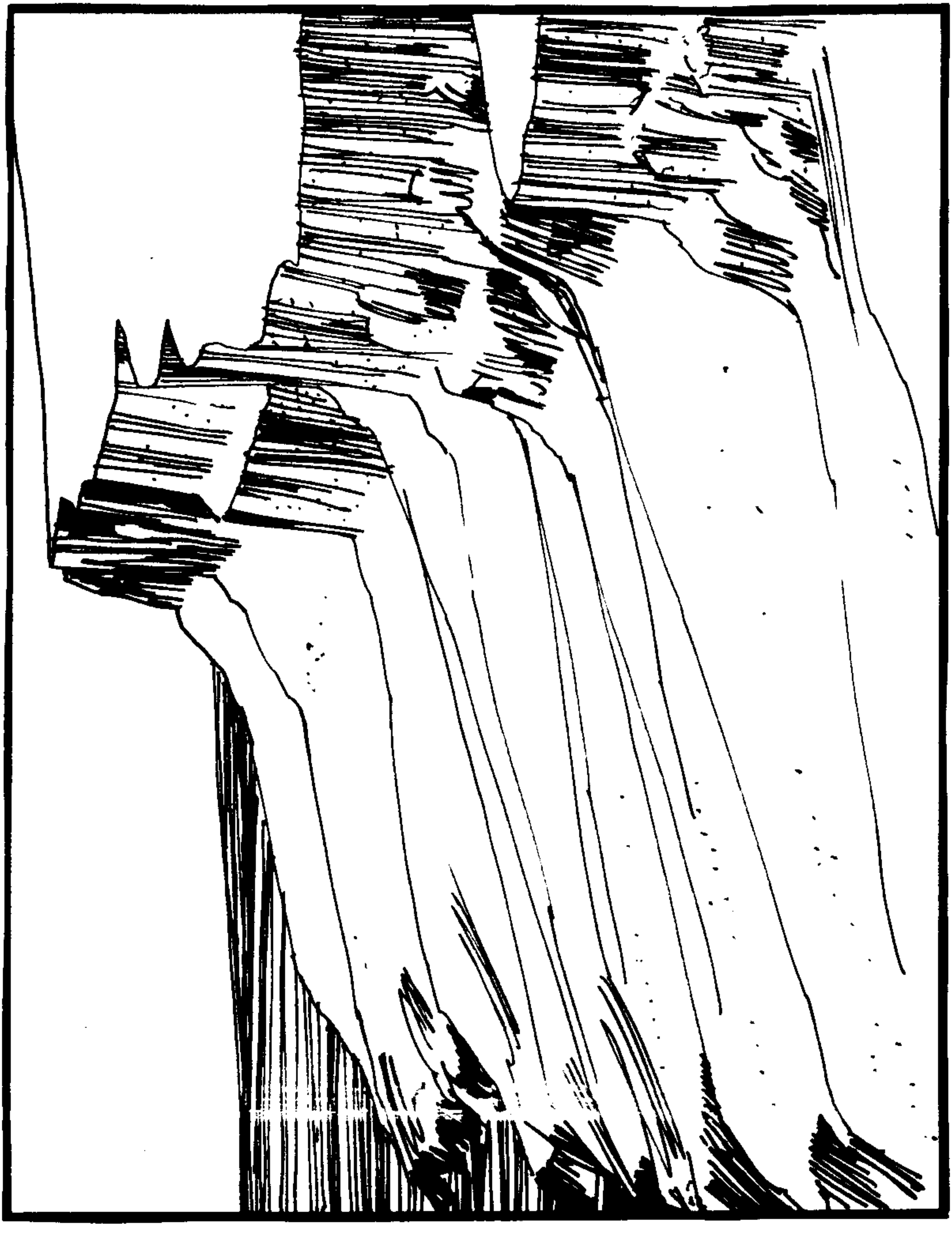
You are now about 100 nautical miles from Galveston. As you look out of the minisub, GOMUER, you see coral of all colors around you and at least 40 different species of fish. You are in the Flower Gardens Reef. This is the northern most coral reef in the Gulf and Atlantic Ocean. The water around you is calm today so you are able to see the surface which is 60 to 80 feet above you. As you look around, you see that the reef covers an area of 2 to 3 football fields. The aquanuats tell you that there are other coral reefs in the Gulf but they are not living.

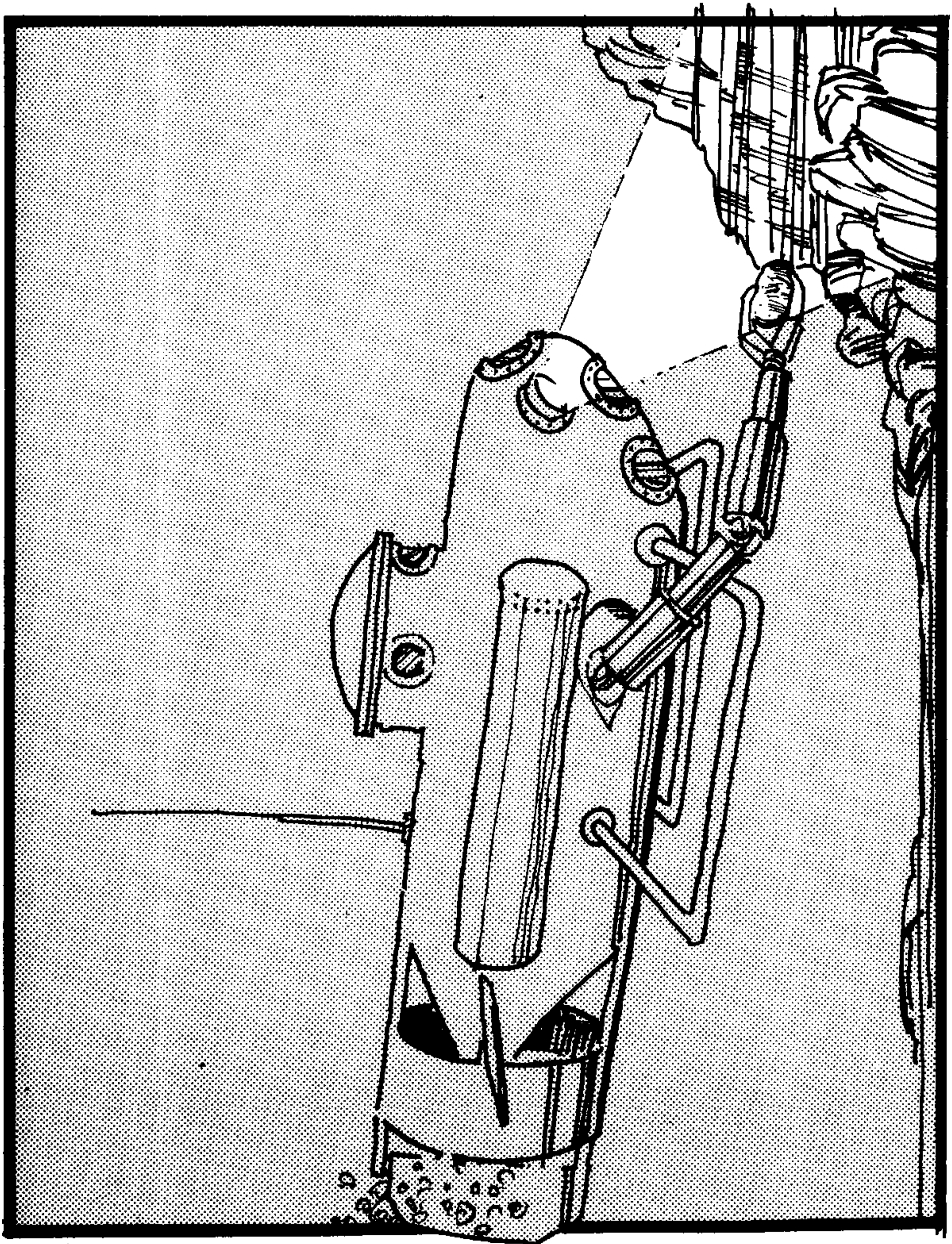
As your minisub moves seaward again, you see that the slope is much steeper and the sub is moving down. This area is the continental slope. The slope is 15 to 90 times steeper than the shelf. This is steeper than going down our steepest mountains on land. We have now dropped to a depth of 10,800 feet. (the average depth for continental slopes is 12,000 feet; some are much deeper). As the minisub moves down the slope, you notice that it is getting darker and you no longer see any plants. One of the aquanauts turns on the flood lights so you can see. The light shows you that the slope is cut by canyons, gullies and small valleys. At the sub turns east, or to your left, the light picks up the features of a spectacular canyon cut into the slope. You are told this is Alaminos Canyon. The aquanaut points out that it begins on the shelf and that many canyons of this type are an extension of a river on a coastal plain and continue down the continental slope as far as the deep ocean. At the seaward end of the canyon, you see a large featureless apron slopingvery gently seaward. This is built from sediment from the continent which flowed through the canyon and was deposited on the ocean floor. You are told that this sediment, which is thick enough to bury the bottom features, is the continental rise. Also, the Gulf of Mexico receives all the sediments from all of the United States lying between the Rocky and Appalachian Mountains. The Mississippi River alone brings a load of sediment of approximately 2 million tons into the Gulf each day.

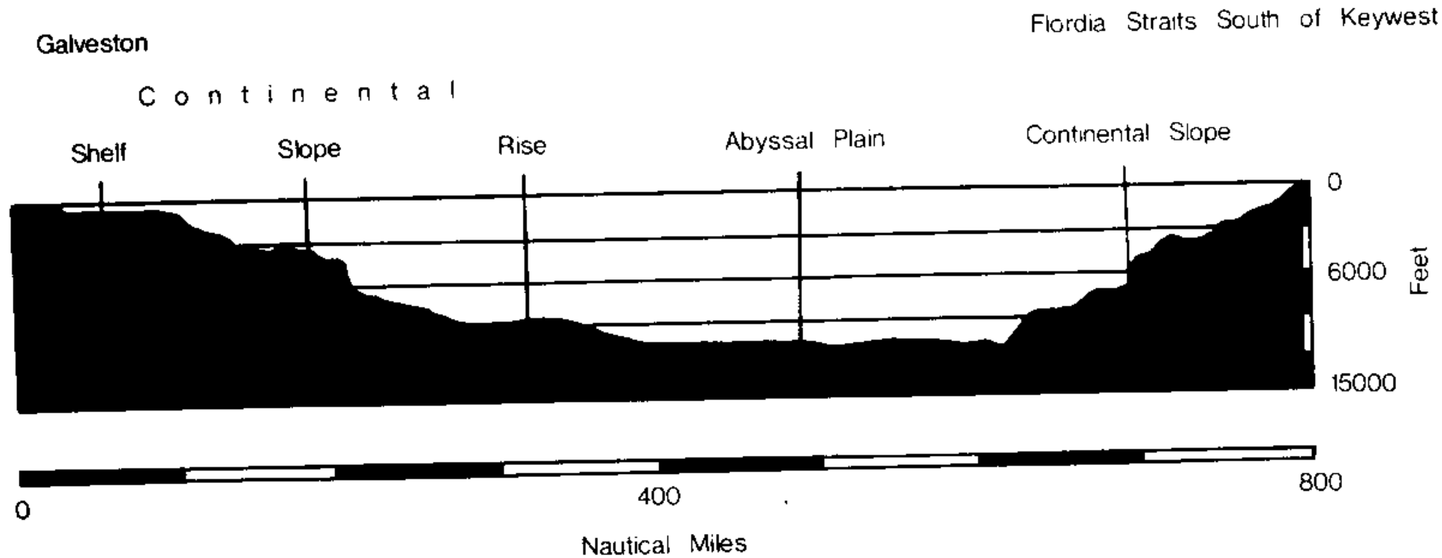
As the minisub leaves the continental rise behind, you are at a depth of 11,875 to 11,930 feet. It is dark, and you can only see with the use of lights. This is the Sigsbee Abyssal Plain, the floor of the Gulf. This vast area of the Gulf floor has been buried by the sediments from the Mississippi and other rivers to form the plain which is flatter than any plains on land. You see a series of hills which rise 1200 feet above the plain. The sub now turns right and heads out the Sigsbee Deep, the deepest point of the Gulf which is 12,425 feet in depth.

Now it is time for your submersible to head back to Galveston and surface. Hope you had a good trip. Reporters are asking you about what you saw. The cameras on the minisub did not take good pictures. Use the paper and materials the teacher gives you to draw a picture of any part of your trip you want to share with others.

Share your drawings and impressions with your classmates.







Cross Section View of Gulf of Mexico on a Line Between Galveston and the Florida Straits South of Keywest

As you were leaving the minisub, one of the aquanauts gave you some sketches he made of the shelf, slope and plain. He didn't label them--can you label them correctly? Label sketches.

Fill in the chart. Based on your trip and using the aquanaut's sketches and the following diagrams of the cross section of the Floor of the Gulf of Mexico. See if you can fill in the following chart.

CHART OF CHARACTERISTICS OF THE FLOOR OF THE GULF

	Description & Location	Depth	Width Size	Surface Appearance
Continental Shelf				
Continental Slope				
Ocean Basin--Abyssal Plain				

Answer

Is the width of the shelf the same in all areas?

Which area is the deepest?

What is the most flat?, the steepest?

Which area looks like the land it touches?

Which is part of the continent?

THE SHAPE OF IT!
MURAL OF THE GULF'S FLOOR

LESSON TWO

ACTIVITY TWO

Plan -

A section of a mural of the Floor of the Gulf of Mexico.

Draw, paint
and construct -

A mural of the Floor of the Gulf of Mexico.

<u>Optional</u>
Construct -

A clay model of the ocean floor showing the features of the continental slope, shelf, rise and abyssal plain.

Demonstrate -

How water covers the features of the ocean floor by submerging the model you constructed in a glass container of water.

<u>Optional</u>
Look up -

Features that are found in Atlantic and Pacific ocean floors but not in the Gulf of Mexico.

Sketch -

Features of ocean floors not found in the Gulf.

Write -

A story describing a trip to the Atlantic or Pacific Ocean floor.

<u>Optional</u>
Read -

Article on exploration and study of ocean floor.

Report -

To the class on the article you read.

MURAL OF GULF'S FLOOR

Prepare a sea floor mural. Use paper which can be hung on the classroom wall. Your group will be responsible for a section of the mural. The sections of the mural are: beach, continental shelf, continental slope, abyssal plain, and submersibles. You will be assigned a section.

Draw your section of the mural to scale showing depth. You will have to work closely with the other groups since your sections of the mural must fit together with their section. The plants and animals will be added later. If your group is responsible for the submersibles section, you will sketch submersibles and place them on the mural at the depth to which they can descend.

The section that I am responsible for is ______________________.
Things that need to be included in this section are:

Make sketches or plans for your section below:

LESSON THREE
THE PHYSICAL CHARACTERISTICS OF THE OCEAN

Suggested Time for Classroom Use of Material: Approximately 7 to 10 class periods

Materials for Classroom Use:

Water
Salt
Glass container, food coloring, ice, heat source, medicine dropper
Audio tape: Sounds of the Gulf
Light Penetration/drawing
The Light and Dark of It/activity and questions
Temperature of the Gulf of Mexico/chart
Salt Water and Freezing/activity
Salinity of the Gulf of Mexico/chart
The Force-Pressure/reading and questions
Density and the Sea/activity
Major Ocean Currents/drawing
Currents/reading
Tides/reading and sketch
Waves/reading
Make Waves/experiment and questions
Say It With a Dance/activity

Major Objectives for Activity: After completing the lesson the student will be able to:

1.1 to define salinity, pressure, density, tides, currents, and waves;

1.5 discuss the factors which affect the smell and taste of water;

1.5 describe the sounds that are heard in the water;

1.5 state the factors that affect light penetration in water;

1.5 discuss the importance of light penetration;

1.5 state the factors that affect the temperature of water;

1.5 describe the characteristics of sea water and the behavior of ice in sea water;

1.5 analyze the factors that affect the salinity;

1.5 describe the effect of pressure in the sea;

1.5 state the factors that affect the density of sea water;

1.5 construct a model to illustrate currents;

1.5 make a statement relating density of water to the movement of water masses;

1.5 explain the formation of waves;

1.5 illustrate the relationship between tides and the gravitational forces of the earth, the moon and the sun;

1.5 explain how the flow of energy from the sun generates currents;

1.5 construct an experiment to illustrate the causes of waves;

1.5 describe the effects of currents on climate;

2.7 cite ways in which currents affect and have affected man;

2.7 cite examples to illustrate why the knowledge of tides and currents is important;

4.1 analyze the feelings and perceptions that sounds of the Gulf produce;

4.1 evaluate the feelings produces by waves, tides, and currents.

Teaching Suggestions: The purpose of this lesson is to present information to the student on the physical characteristics of the marine environment and factors affecting these characteristics.

1. Have the students complete the readings, activities and respond to the questions and/or activities.

2. During the days on which these activities are used,

have the students meet in small groups to discuss the questions and/or cooperatively work on activities.

3. After each activity have a class discussion on the questions and/or activities. Encourage students to generate related questions and then strive to answer them cooperatively.

4. The audio tape was taken from the album Sounds of Sea Animals, Vol. 2, Folkways Science Series Fx 6125, Folkways Records & Service Corp. 43 W. 61st, N.Y. 10023

5. The sounds as they appear on the tape are:
    1. snapping shrimp
    2. toadfish
    3. trigger parrotfish
    4. sea catfish
    5. single catfish
    6. white grunt
    7. drumfish
    8. cowfish
    9. manatee
    10. one porpoise
    11. school of porpoises

THE PHYSICAL CHARACTERISTICS OF THE OCEAN
THE SMELL AND TASTE OF THE SEA

LESSON THREE

ACTIVITY ONE

Smell -

Two water samples.

Answer -

The questions on water and its smell.

Taste -

Two water samples.

Answer -

Questions on the taste of water.

Evaporate -

Two water samples.

Observe -

Experiment.

Answer -

Questions.

SMELL

This is Capt. Al G. Seaborne again. I would like you to help me check out some of the ocean's physical characteristics in the Gulf. Let's begin by using our sense of smell. You have two samples of water. Sample A is distilled water. Sample B is salt water.

Smell each sample of water.

Answer

1. What does each sample smell like:

2. What do you think gives water its odor?

3. What would make water smell bad?

4. What could you do to change the smell of water (either good or bad)?

5. What effect do you think pollutants would have on the smell?

Taste -

1. The distilled water sample.
2. The sea water sample.

Answer -

1. How would you describe the taste of the distilled water?

2. How would you describe the taste of the sea water?

3. What makes the sea water taste the way it does?

4. Can we change sea water to fresh water?

Evaporate -

1. A sample of distilled water.
2. A sample of sea water.

Answer -

1. Do you get the same results from evaporation of each sample? Explain.

Taste -

1. The material left after the evaporation of each sample.
2. What could you say about what effects the taste of sea water?

3. Would other materials added to water effect its taste?

4. What effect do you think pollutants would have on the taste?

THE NOISY DEEP
(SOUNDS OF THE GULF)

LESSON THREE

ACTIVITY TWO

Listen -

To audio tape of Sounds of the Gulf.

Record -

Your impressions.

Answer -

The questions about the sounds you heard.

Listen -

This is Capt. Seaborne. We are going to investigate the sounds of the Gulf. First close your eyes. Imagine that you and I are standing on the beach with the waves splashing on the beach to our right and sand dunes to our left.

1. Describe what you would hear and feel.

2. List as many of the different sounds that you think you would hear.

Now we will continue our investigation. You and I have now entered the mini-sub and are starting our descent into the depths of the sea again. We stop our descent and our engines are stopped. Our outside microphones are turned up. Let's listen to the sounds around us for a few minutes. (Sounds on audiotape).

1. Record your feelings.

2. List as many of the different sounds you heard as you can remember.

3. What do you think makes these sounds?

4. If you were a sailor on a sailing ship in the 1700's lying in your bunk and heard these sounds, how would you feel and what would you think they were?

5. Are these sounds the sounds of Ghosts and Spirits about which sailors of the past talked? Why or why not?

THE LIGHT AND DARK OF IT

LESSON THREE

ACTIVITY THREE

Complete -

The activities in The Light and Dark of It.

Look at -

Drawing of Light Penetration.

Answer -

The questions.

THE LIGHT AND DARK OF IT

Look at -

An object in the room. Now look at the same object through salt water.

Record -

Your observations.

Look at -

The same object through water solution with dirt or sand mixed in it.

Record -

Your observations.

Answer -

1. Was there a difference in your being able to see the object? Explain.

2. What made the difference:

3. Can you see underwater as well as you can see on land?

4. Would you be able to see in 10 feet of water as well as in 5,000 feet of water? Why or why not?

5. What must be present so you can see an object: (Why can you see an object better during the day than at night?)

Look at -

The drawing on light penetration and use it to help answer the questions. Sea water is a barrier to light. Usually not enough light penetrates beyond 1.600 feet (490 meters) to be visible to the human eye. In coastal waters, light may not penetrate more than a few inches or centimeters.

Answer -

1. Would you be able to see on the floor of the Gulf (12,000 ft.)? Explain.

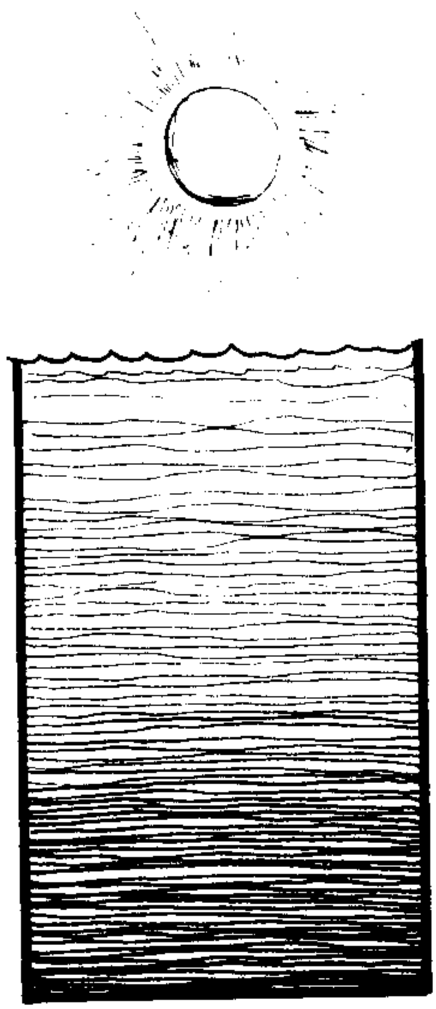
2. Why are no plants generally found below 650 feet?

3. Would the light penetrate the water in the middle of the Gulf of Mexico the same distance as near the mouth of the Colorado, Brazos, or Mississippi Rivers? Explain.

4. What effects how far the light penetrates through the water or how well you can see?

5. How can man affect the light penetration?

LIGHT PENETRATION



THE HOT AND COLD OF IT

LESSON THREE

ACTIVITY FOUR

Look at -

Chart on Temperatures of the Gulf of Mexico.

Answer -

The questions on The Temperature of the Gulf's Waters.

Read -

Salt Water and Freezing.

<u>Optional</u>
Set up -

Experiment to determine the freezing point of sea water with varying amounts of salt.

Investigate -

Frozen salt water.

Answer -

The questions on Salt Water and Freezing.

TEMPERATURE OF THE DEPTHS

Temperature		Depth	
* 87°F - 30°C	Mixed Layer	0 ft	0m
79°F - 26°C		300 ft	91m
70°F - 21°C		600 ft	182m
60°F - 16°C		1,200 ft	365m
50°F - 10°C		1,800 ft	548m
41°F - 5°C		3,000 ft	914m
40°F - 4°C		4,200 ft	1,280m
39°F - 3°C		6,000 ft	1,828m
35°F - 1°C		36,000 ft	10,973m

* These are summer temperatures. During winter shallow coastal water temperatures will vary significantly depending on surface weather conditions. Winter temperatures near edge of continental shelf will average between 70° - 75°F (21° - 25°C).

THE HOT AND COLD OF IT

It is time to continue our investigation of the Gulf's physical characteristics. Look at the information collected by the aquanauts in GUMUER. Look at the chart on Temperatures of the Gulf of Mexico.

The area from sea level to a depth of 300 ft. is referred to as the "surface waters" since the water is affected by waves, wind and etc. It will change temperature throughout the year. The change depends on the location.

Answer

1. Why does the temperature of the surface waters vary?

2. Why is the temperature of the water different in the winter than in the summer?

3. What is the water temperature at 3,000 ft.?

4. What is the water temperature at the bottom of the Gulf?

5. The deeper the water, the warmer or colder the temperature?

6. What will happen if the water temperature drops below 28°F?

SALT WATER AND FREEZING

The freezing point of salt water differs from the freezing point of fresh water. The exact temperature at which salt water freezes varies with the amount of salt it contains. The more salt it contains, the lower the freezing point. The usual range for the freezing point of sea water is from 28° to 31°F while the freezing point of fresh water is 32°.

Optional Activity

Set up an experiment to determine the freezing point of sea water with different amounts of salt dissolved in it.

Investigate frozen salt water.

1. Freeze some salt water in an ice tray.
2. Put the frozen salt water in tap water.
3. Explain what happens.
4. Taste some frozen salt water. Does it taste salty? Explain.
5. How do you expect the ice in ice bergs to taste?
6. Discuss the possibility of towing of icebergs to desert areas as a source of fresh water.

A LITTLE SALT AND THE FORCE

LESSON THREE

ACTIVITY FIVE

Look at -

The chart on salinity.

Answer -

The questions on salinity.

Read -

The Force-Pressure

Answer -

The questions on pressure.

A LITTLE SALT

From our testing activity we know that the ocean is salty. Salinity is the measure of the amount of dissolved salts in sea water. Changes in salinity are caused primarily by evaporation and precipitation and by river discharge from the continents. These are the results we find in the Gulf of Mexico.

SALINITY OF THE GULF OF MEXICO

Area	Salinity (grams of salt per kilogram of water)
Over central Gulf of Mexico Basin	36.0 to 36.3
Edge of Yucatan Shelf	As high as 36.6
Several miles offshore from mouth of Miss. River	Less than 25.0
Oceans	Average 35

1. Why does the salinity vary? What factors would cause Laguna Madre (Bay which extends from Corpus Christi to Port Isabel) to reach a salinity of 130 during droughts?

2. Will heavy rains increase or decrease salinity? Explain.

3. Why would the salinity several miles offshore from the mouth of the Mississippi River be less than the central Basin area of the Gulf?

4. When would you expect the Gulf to have its highest salinity, mid spring or mid summer? Why?

THE FORCE-PRESSURE

The pressure in the sea is the force with which water pushes on an object. The pressure changes with the depth of the water. At sea level, the pressure is about 14.5 pounds per square inch or one atmosphere on our bodies. The pressure increases at 14.5 pounds per square inch for every 33 feet of depth, or one atmosphere. At a depth of 300 ft. the water pressure is approximately 132 lbs. per sq. inch. At the depth of the Sigsbee Abyssal Plain in the Gulf, the pressure would be 360 times that of sea level or 5228.8 lbs. per sq. inch or 2.2 tons per sq. inch. In the deepest depths of the oceans, the pressure reaches 14,000 lbs or 7 tons per square inch. Man can only dive to a depth of ________ without a specialized suit to resist the pressure.

Instrumeets used to study the ocean must be able to stand the pressure changes. One of the problems facing designers of submarines and submersibles is to construct them strong enough to stand the great pressures of the ocean depths.

Answer

(1) As the depth of the water increases, does pressure increase or decrease?

(2) Why don't we feel the 14.5 pounds per square inch of pressure on our bodies at sea level?

(3) What must man do to explore the depth of the ocean?

(4) What would happen to our bodies if we stepped out onto the floor of the Abyssal Plain? (Pressure 2.2 tons per square inch)

(5) Could the animals that live in the surface waters also live in the deepest areas of the ocean? Explain.

DENSITY AND THE SEA

LESSON THREE

ACTIVITY SIX

Read -

Density and the Sea

Conduct -

An experiment to understand the importance of salinity and water density.

Answer -

The questions about the experiment.

Conduct -

An experiment to demonstrate the effect of temperature on the density of water.

Sketch -

The experiment and show the water movement.

Answer -

The questions on the effect of temperature and the density of water.

Demonstrate -

A two-layered system of water like the ocean.

Sketch -

The results of the demonstration of the water system like the ocean.

Answer -

The questions on water movement and density.

DENSITY AND THE SEA

Another physical factor of sea water at which we want to look is density. Density is the weight of sea water compared to an equal volume of fresh water at 4°C (39.2°F) and at one atmosphere of pressure. The density seems to be controlled by 3 factors: temperature, salinity and pressure. Temperature and salinity are the most important. Seawater density is increased by increasing salinity or by cooling. The density of sea water may vary slightly but the differences in density may cause changes in the movement of whole water masses. Differences in density are one of the basic causes of ocean currents.

Experiment-Importance of salinity and water density.
Conduct an experiment to understand the importance of water density.

1. Fill a glass with fresh water from the tap.

2. Fill a medicine dropper with salty water, colored with food coloring.

3. Put a drop of colored salty water into a beaker (glass) of fresh water. The fresh water and salt water should be the same temperature.

4. Reverse the procedure: Put a drop of colored fresh water into a beaker of salty water.

Answer

1. What happens to the drop of salt water put into a beaker of fresh water?

2. What happened to the drop of fresh water put in salty water?

3. Which is more dense the salt or fresh water?

EXPERIMENT-THE EFFECTS OF TEMPERATURE ON WATER DENSITY

Conduct an experiment to demonstrate the effect of temperature variations on the density of water.

1. Place a beaker (dish) of water on a stand.
2. Place ice in the water on the side of the dish.
3. Heat the other side of the dish.
4. Add a small amount of ink or food coloring so the water movements will be more visible.
5. Make sketch of the experiment. Add arrows to the sketch to show the direction of the water.

Answer

1. Does the warmed water rise or sink?
2. Does the cooled water rise or sink?
3. Which water will sink, the more or less dense water?
4. Which water is the more dense, water from the north pole or the equater?
5. As water from the north pole moves south would you expect it to sink or rise?

DEMONSTRATION OF A WATER SYSTEM LIKE THE OCEAN

Conduct an experiment to demonstrate a two-layered system like the ocean.

1. Dissolve as much salt as the water in a half filled container will hold to make dense salty water. (Add salt until some remains undissolved after vigorous stirring.)
2. Carefully pour fresh water on top of the salty water. After the water movements caused by adding the fresh water layer have stopped, you should have a two layer system where dense salty water lies below the fresh water.
3. Use the medicine dropper, to add a drop of slightly salty colored water to the fresh water. Observe the results.
4. Use eye dropper to add a drop of slightly saltier colored

water down into the very salty water and release the drop. Observe the results.

Complete a sketch of the results by showing how the drops moved from each dropper.

1. Which water mass will sink, the more or less dense water?

2. Does sea water become more or less dense when the salinity is decreased by adding fresh water?

3. Will the water from the Mississippi River stay on top or sink as it flows into the Gulf of Mexico?

4. Would the water from Laguna Madre during the summer (higher salinity than the Gulf of Mexico) stay on top or sink as it enters the gulf of Mexico?

5. Make a statement relating density of the water to the movement of the water masses.

IT MOVES!

LESSON THREE

ACTIVITY SEVEN

Read -

Currents

Look at -

Diagram of Main Ocean Currents.

Answer -

The questions on the currents.

Look at -

Drawing of tides.

Read -

Tides

Answer -

The questions on tides.

<u>Optional</u>
Read -

"Young Naturalist: Tides" Article in Texas Parks & Wildlife Nov. 1974 pp. 29-31.

Read -

Waves

Experiment -

To determine the causes of waves.

Answer -

Additional questions on waves.

Illustrate -

The different types of waves, tides and currents through dances.

CURRENTS

Oceans waters continously move. If you sail or swim in the ocean, you know about the movements of water we call currents. Some currents affect only a small area, such as a beach. These are the oceans' response to local, often seasonal, conditions like rainfall. Other currents are permanent and involve large parts of the ocean.

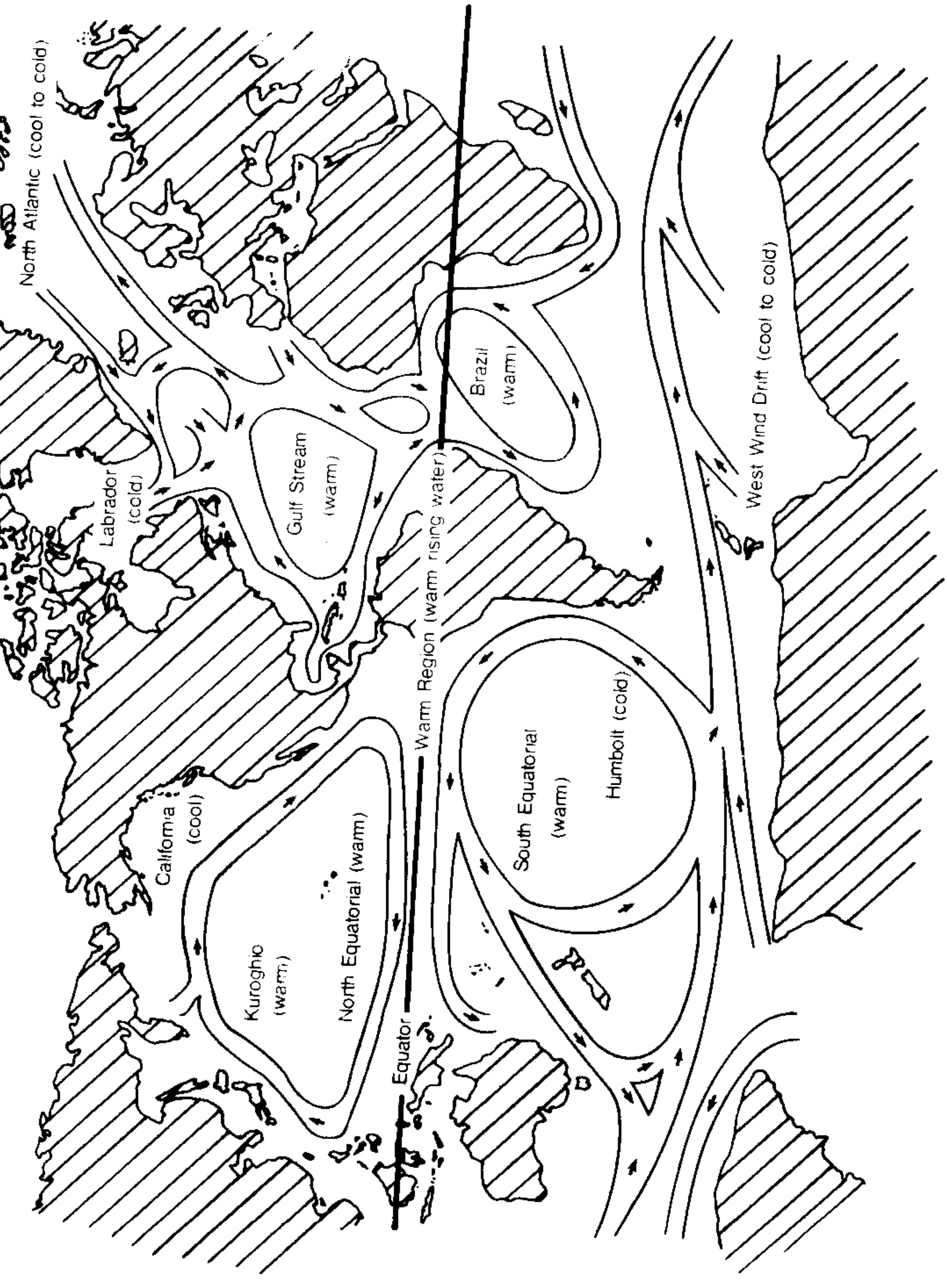
The major ocean currents are basically caused by differences in density and wind. Look at the sketch of the major ocean currents.

Some currents have definite boundaries in which they flow through the ocean. These we call streams, since they are like rivers of water moving along regular routes. The Gulf Stream current is an example. It is warmer than the surrounding ocean since it originates near the equator. It has a definite effect on land temperatures-warming them. The stream begins as a result of temperature, low pressure and wind action. Heating near the equator causes the water to expand and move northward in a well-defined stream into the Gulf of Mexico through the Yucaton Channel. Part of it then leaves the Gulf of Mexico and flows along the Atlantic coast.

The currents affect us in many ways:

1. In navigation.
2. Their temperature and speed affect the climate of the land. For example, palm trees grow near the Artic circle in northern Scotland. Areas the same distance from the equator may differ in temperature and moisture.
3. Effect plant and animal life.
4. In history-Ponce de Leon used the Gulf Stream. Ben Franklin used knowledge of currents to get mail shipped to England and the U.S. faster.
5. Movement of people-The Incas from Peru to the Eastern Islands-(Thor Heyerdahl-Kon Tiki) Mediterranean culture to the Americas (Thor Heyerdahl-Ra Expeditions)

MAIN OCEAN CURRENTS



1. Where do most of the major ocean currents begin? (Use sketch of major ocean currents.)

2. Is the temperature of the water warm or cold where the major currents begin?

3. In what direction do the major currents move?

4. What happens to the temperature of the currents at the pole regions?

5. Once the currents reach the poles in what directions do they move?

6. What effect would the Gulf Stream current have on the land nearby?

7. In the summer, San Francisco boasts that it is an "air-conditioned" city with temperatures of 59° and 63°F in July and August. Explain why.

8. Could knowledge of the ocean currents benefit us in the future?

9. Use the sketch of the major currents. Discuss the possible role of currents in bringing people from one area to another part of the world.

TIDES

Some of you live in the interior and you may scarcely have heard of tides. Those of you who live along the coast know very well what tides are and how important they are. Tides also behave like waves, but are so large that their wave-like characteristics are easily overlooked.

What are tides? Tides are the alternating rising and falling of water in the oceans and their tributaries. You probably know that the moon is mainly responsible for the tides. (The sun is also, to a lesser degree.) Looking at the sketches we see that water on the side of the earth facing the moon is drawn by the moon's gravity slightly toward the moon. At the same time the earth is pulled slightly away from the water on the opposite side. The two bulges, one toward the moon and one away from it, of the water, are high tide. Between the two buldges, the water is drawn toward the earth by its gravity, causing a flattening or low tide. Another factor that affects tides is the shape of the basin. Therefore the Gulf of Mexico has all three types of tides, but responds better to the daily forces. The tides in the Gulf of Mexico, because of the basin shape, are mixed. This means some days there are 2 high and low cycles, others only one, others one high and two lows and still others two highs and one low. The average tidal range in the Gulf is small, being only one or two feet at most coastal stations. This may not sound like much, but on a fairly flat beach, the water can move onto shore 20 feet or more. The greatest range of the tides-about 54 feet (16 meters)-occurs at the head of the Bay of Fundy in Novia Scotia.

Tides are carrying in materials and organisms so that during high tide, the streams and marshes are filled with life. Fish enter to spawn and feed. They move out with the lowering water. At low tide mullusks, such as oysters, clams and snails, are left behind in the mud where shore birds feed on them and the leavings of fish.

Tides also aid in distributing plankton. If it weren't for the tides, these minute life forms which are the basic food of all marine life would not be available as for other organisms.

If it weren't for tidal flows, many of the pollutants would be trapped to accumulate and eventually poison the coastal area. However, as the tide flows out, these materials are carried out to sea.

The tides have been a moving force for as long as waters have covered the earth. Man has used this natural force to help him in many ways. Early sailing ships used out-going tides to start them on their trips. People who lived along rivers would block off pools at high tide to trap fish. At low tide, they could easily catch the trapped fish. Man has found that tides will deposit good land for farming. Man has found still another use for tides. Tides are harnessed for producing electricity in power plants.

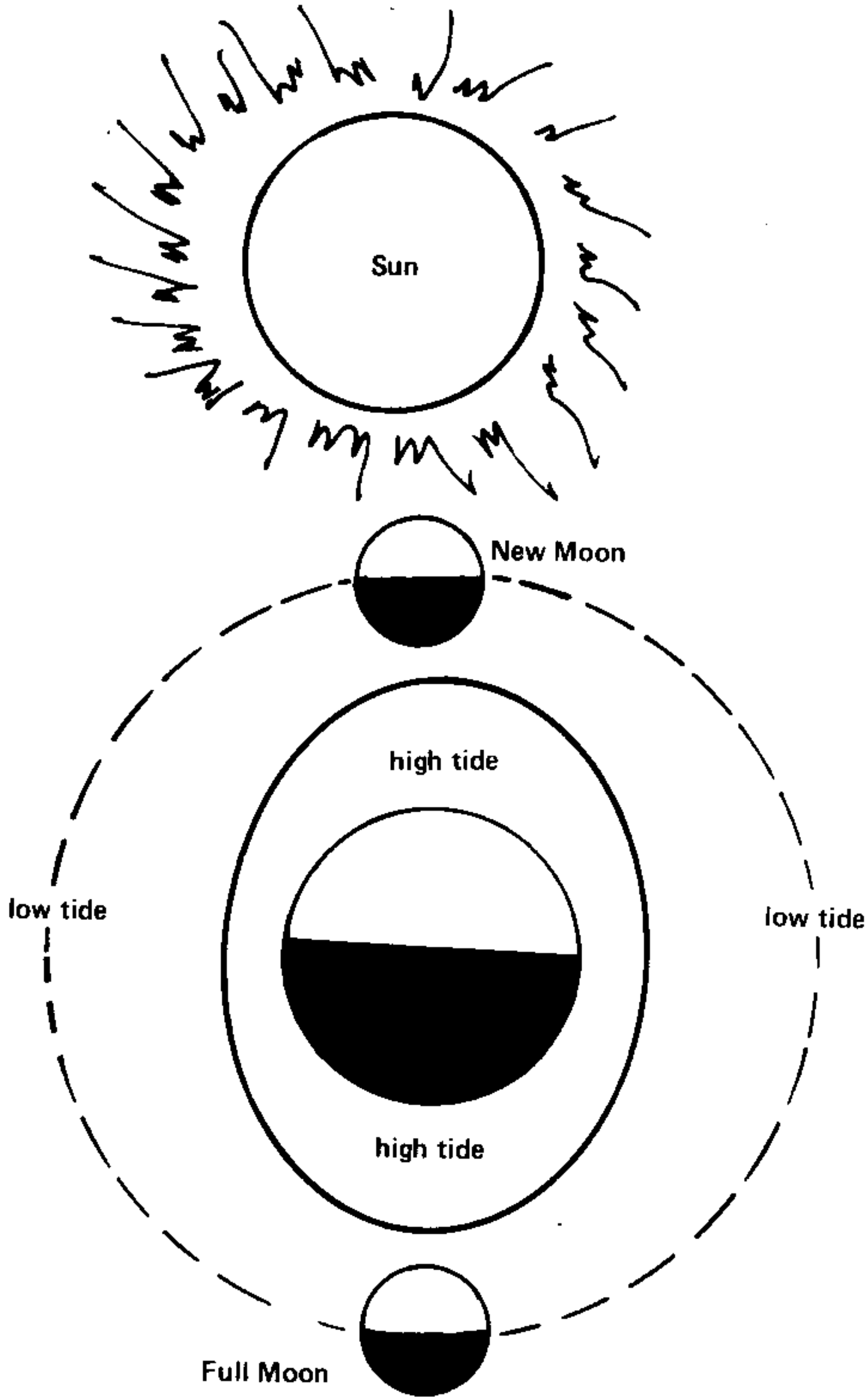
1. What can happen to ships if a seaman fails to check his tide tables?

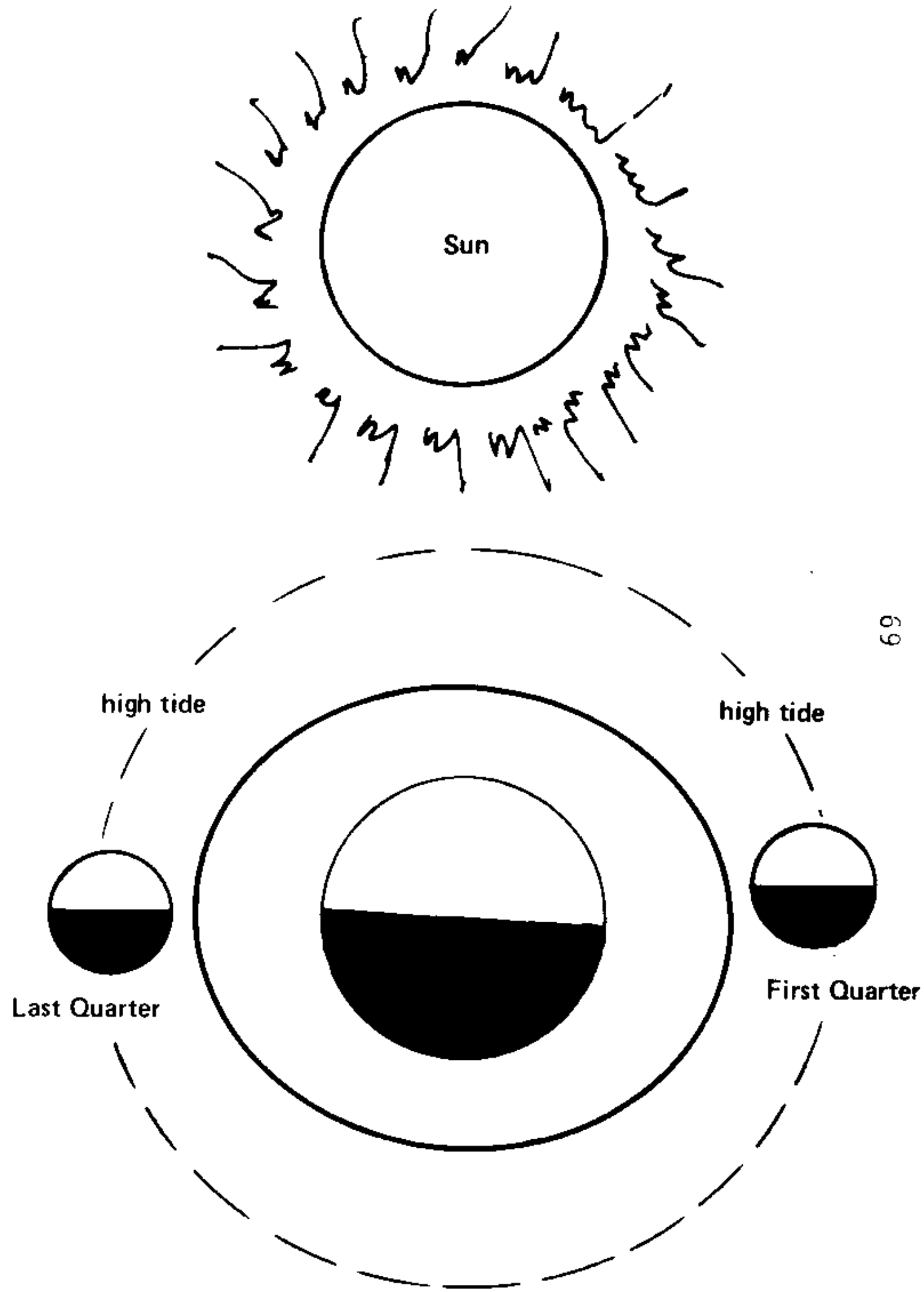
2. You are going fishing on the coast. Could knowing the time of high and low tides be helpful to you in catching fish? Explain.

3. At which tide level would you have the best luck beach-combing?

4. Explain why tides are important to our estuaries, bays and marshes.

5. Could the tides be a source of energy? Explain,


Sun
New Moon
high tide
low tide
low tide
high tide
Full Moon

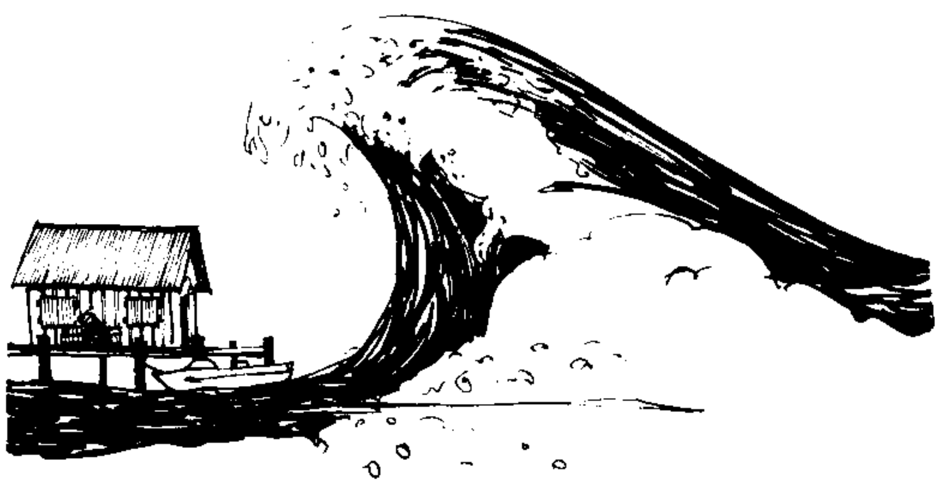

Sun
high tide
high tide
Last Quarter
First Quarter

WAVES

We are by nature wave watchers. We would like to learn the ways of waves by watching them but we cannot because they set us dreaming. Try to count a hundred waves sometime and see.

Waves are not always dream producing. Sometimes they scare us, for they can be among the most destructive forces in nature, destroying ships at sea or towns on shore. We think of waves as being caused by wind, because wind-caused waves are the most common. Wind waves within the Gulf are rarely over 5 meters or 16 feet high.

Seismic sea waves are commonly known as "tidal waves". They are called "tsunami" by the scientists. They are caused by sea floor distrubances, mostly earthquakes. They may travel thousands of miles at speeds of 200 miles an hour before they crash on shore. They cause catastrophic property damage and loss of life,especially in the lands bordering the Pacific Ocean.



Make Waves

Set up experiment to determine the cause of waves.

1. Fill a pan ½ full of water.
2. Blow into a straw over the surface.
3. Observe what happens as you blow harder.

Answer Questions:

1. What was formed as you blew into the straw over the surface of the water?

2. What effect did blowing harder have on the surface of the water?

3. What blows across the surface of the ocean water?

4. Can it form waves? Explain.

5. What kind of waves would a strom cause? Why?

Make Waves Again

Set up another experiment to determine the cause of waves.

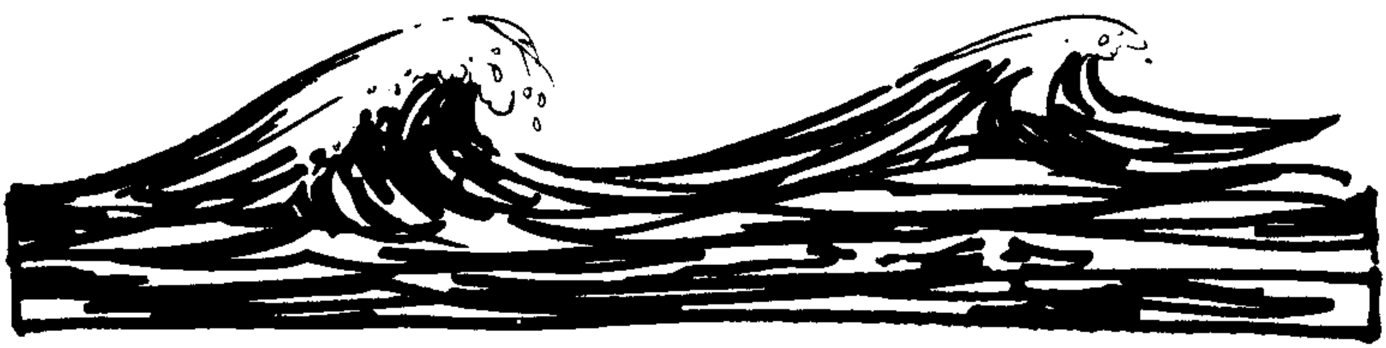
1. Using the same pan of water, place the pan on a desk or chair.
2. Pound lightly on the desk underneath the pan.
3. Pound heavily on the desk to show the effect of sea floor distrubances like earthquakes, volcanoes, etc.
4. Observe the results.

Answer:

1. What happened as you pounded on the desk?

2. What effect would these waves have as they reach the beach?

3. Could we harness waves as a source of energy? Explain.



SAY IT WITH A DANCE

It might be fun to illustrate the different types of waves, tides and currents through dances.

List below the types. Then spend some time thinking of the type of dance for each. What feelings does it show?

Type (waves, currents, tides)   Your dance for them

LESSON FOUR
SEA INTERACTS WITH THE LAND

ACTIVITY ONE-Texas Coastal Climatic Zones

Suggested Time for Classroom Use of Materials: 1-2 class periods

Materials for Classroom Use:
Letter from Sonny Day/reading
Terrian and Climatic Interactions of the Gulf/drawing
Memo from Sonny Day/reading

Major Objectives for the Lesson: After completing the lesson the student will be able to:

1.5 analyze the effect of the Gulf of Mexico on the climatic zones of the Gulf coast region;

1.5 discuss the effect of the extraordinary climatic event (hurricane) on the coastal zone;

1.5 compare and contrast the climatic zones of the Texas Gulf coast;

2.7 cite examples of the influence of the climatic conditions on man's activities;

2.7 relate occupations to the climatic zones.

Teaching Suggestions: The purpose of this lesson is to present information to the student and to get him to start thinking about the effect of water on the climatic conditions of the land.

1. Have the students complete the readings and respond to the questions.

2. After dealing with the readings and drawing, have a class discussion on the questions. Encourage students to generate related questions and then strive to answer them cooperatively.

3. The article "What's Happening to Our Climate?"

National Geographic Vol. 150, No. 5 (November 1976) pp.576-615 has additional information and can serve as a resource for further discussion of the relationship of the oceans and the climate of the earth.

SEA INTERACTS WITH THE LAND
TEXAS COASTAL CLIMATIC ZONES

LESSON FOUR

ACTIVITY ONE

Read -

Letter to Captain Seaborne from Sonny Day.

Look at -

Terrain and Climatic
Interactions of the Gulf Drawing

Label -

Climatic Regions on the diagram.

Read -

Memo to Captain from Sonny Day.

Write -

Two paragraphs. One paragraph should describe the plants and animals one might find in Region A. The other would describe the plants and animals found in Region D.

Answer -

The question on the climatic interactions of the land and the Gulf.

LETTER FROM SONNY DAY

I asked my friend, Sonny Day, at the Weather Bureau to tell us a little about the Gulf of Mexico and the weather along the coast. Here is his letter.

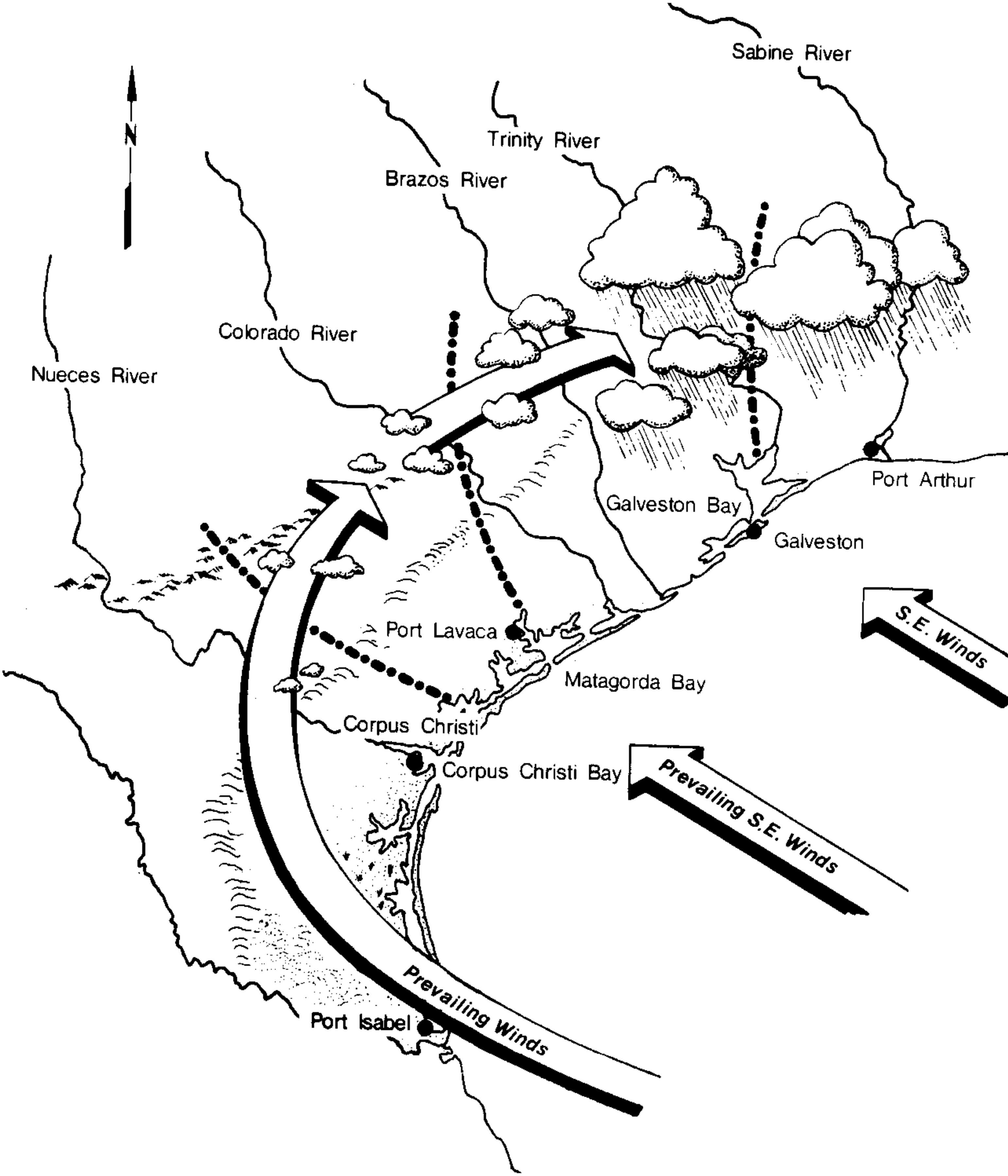
Dear Captain Seaborne,
As you know the oceans affect our weather. They affect not only the weather of the coastal states but much of the United States as well. The overall climate of the coastal area is subtropical with long, warm to hot summers and short, mild winters.

As we look at the Terrain and Climate Map we find that the interaction of the climate (weather of an area over a period of time) and the terrain along the Texas coast, create four distinctly different regions. From Sabine River (Port Arthur) to Galveston we find a humid climate. Label this Region A. Then extending from Galveston to Port Lavaca (label this Region B) we find the wet subhumid climate where the moisture supply and loss are in balance. This is not true in the next zone, from Port Lavaca to Corpus Christi (label this Region C) is a dry, subhumid belt. The transition between the dry subhumid region to that of semiarid (label this Region D),or almost desert,of the coast from Corpus Christi to Port Isabel, is gradual.

In the vincinity of Matagorda Bay there is an important climatic boundary. South of Matagorda Bay, the potential evaporation rate is greater than the annual rainfall. So south of this area, fresh water is in short supply. North of this area, the average annual rainfall is greater than the potential evaporation. This climatic factor is seen in the terrain along the coast. Is there a difference in the upper coast as compared to the lower coast? The surface climate has a direct effect on the marine environment. Roughly from Matagorda north, organisms are very similiar to those off the coast of the temperate Atlantic (Carolinas and Virginia). However, from the Matagorda area south, tropical and subtropic organisms, like those of the Carribbean occur. Yes, the size of the bays and river basins are smaller in the semiarid region compared to those in the humid region. Why? The amount of rainfall is less so the rivers carry less water so the bays are smaller. The bays and estuaries will also be saltier in the summer, due to greater evaporation. Another feature is that as we move toward the lower coast, we find large areas of wind-blown sand. Again due to the decrease in vegetation caused by the decrease in rainfall.

Sincerely,
Sonny Day
Sonny Day
U.S. Weather Bureau

TERRAIN AND CLIMATIC INTERACTIONS OF THE GULF



MEMO: Capt. Seaborne

FROM: Sonny Day

Here is some information that I forgot to include in my letter. Another important climatic factor along the Gulf coast is the occurrence of extraordinary climatic events, such events as hurricanes, tornadoes, and heavy rainfall. The tornadoes and heavy rainfall may or may not be associated with hurricanes or tropical storms. Hurricanes strike the Texas coast on the average of once every 1.5 years.

During a hurricane, conditions along the coast are drastically changed and rather violent conditions may exist for a few hours to a few days. These conditions are: (1) a barometric low that causes a rise in the water level along the Gulf, (2) strong wind, (3) rising tide, (4) large waves (waves may grow 40 or 50 feet when a storm covers a large area), (5) heavy rains. So when the storm strikes the coast, it (1) erodes beaches and dunes, (2) moves sediment, (3) floods lowlands.

The weather can and does interact with the land, sometimes this interaction is violent and sudden, causing drastic changes in the coastal environment.

Sonny Day

Questions:

1. Why would we find more windblown sand on the lower coast?

2. What effect do you think climate has on the salinity of the bays in Region A in comparison to D?

   Would they have a different salinity?

   Which would have the greater salinity?

   Would this effect the plants and animals?

3. How would the climate affect the agriculture of the region?

   In which regions would rice and timber be important?

   In which region would cotton, fruits and vegetables be important?

   Which regions would have to use irrigation?

   Would you expect to find the same cattle in each region?

   Would one kind of cattle be better for Region A versus Region D?

5. Do you think the climate would effect the kinds of jobs available? Explain.

6. Write a paragraph describing a coastal area before and after a hurricane passed through the area.

7. What effect would the large movement of water into the bays and estuaries (with high tides) and then out again with the rainfall have on the plants & animals of the bays and estuaries?

8. How does the possibility of hurricanes affect people living along the coast? structure of buildings? insurance? jobs?

9. Should man work to control hurricanes? How willing are you to contribute money to be used to learn more about hurricanes to control them?

LESSON FIVE
THE MARINE ENVIRONMENT AND MARINE ORGANISMS

ACTIVITY ONE-Zones of the Marine Environment
ACTIVITY TWO-Marine Organisms
ACTIVITY THREE-Intertidal Ecosystems

<u>Suggested Time for Classroom Use of Materials:</u> Approximately 4 to 8 class periods

<u>Materials for Classroom Use:</u>

Zones of Marine Environment/reading and questions
Zones of Marine Environment/sketch
Nutrients and Salts/sketch
Dissolved Oxygen/sketch
Light Penetration/sketch(See Lesson 3)
Chart of marine zones and abiotic characteristics
The Nekon/reading and sketch
The Plankton/reading and sketch
The Benthos/reading and sketch
Distribution of Marine Organisms/sketch
Questions on distribution of marine organisms
Aerial View of Coastal Habitats/sketch
Profile of Coastal Habitats/sketch
Marine Ecosystem /reading
Rocks, Jetties and Groins/reading & sketch
Sandy Beaches/reading & sketch
Oyster Reef/reading & sketch
Salt Marshes/reading & sketch
Mud Flats/reading & sketch
The Water, Itself/reading & sketch
[Reference for sketches Jetties, Sandy Beach, Mud Flats and The Water are courtesy Reader's Digest <u>Secrets of the Seas Marvels and Mysteries of Ocean and Islands</u>]
Let's Get Aquainted
Syntu about a marine organism
<u>National Geographic and Texas Parks and Wildlife</u> magazines

<u>Major Objectives for the Lesson:</u> After completing the lesson the student will be able to:

1.1 define abiotic and biotic factors;

1.1 cite examples of abiotic and biotic factors in a given ecosystem;

1.1 draw a cross section showing the zones of the marine environment;

1.1 compare and contrast the zones of the marine environment;

1.1 if given organisms, classify them as benthos, plankton and nekton;

1.1 distinguish between environment and ecosystem;

1.2 compare and contrast the characteristics of different marine ecosystems;

1.2 describe how abiotic and biotic factors influence the distribution of marine organisms;

1.2 cite an example of marine organisms being adapted to their environments in different ways;

1.2 if given a set of abiotic factors (light, temperature, pressure, chemicals, etc.), to relate to the ecological relationships that exist;

1.2 if given two or more ecosystems, to identify common structural and functional characteristics;

1.3 explain the role of the phytoplankton in the ecosystem.

<u>Teaching Suggestions:</u> The purpose of this lesson is to present to the student information and help get him to recognize the zones of the marine organisms and ecosystems in the intertidal zone.

1. Have the students look at the sketches and complete the readings and activities.

2. Encourage the students to gather additional information and generate related questions. The National Geographic and Texas Parks and Wildlife Magazines have numerous articles with excellent color photographs. Encourage the students to use these magazines.

Below is a list of some of the articles on marine organisms and environments. (These articles can also be used in Lesson Six.)

<u>National Geographic Magazine</u> Articles

Starfish Threaten Pacific Reefs, Vol. 137, No. 3 (March 1970) pp. 340-354
Diving into the Blue Holes of the Bahamas Vol. 138, No. 3 (Sept. 1970) pp. 347-363
Sea Islands:The South's Surprising Coast, Vol. 139, No. 3 (March 1971) pp. 366-393
The California Gray Whale Comes Back, Vol. 139, No. 3 (March 1971) pp. 394-415
Shy Monster, The Octopus, Vol. 140, No. 6 (Dec. 1971) pp. 776-800
The American Lobster, Detectable Cannibal, Vol. 143, No. 4 (April 1973) pp. 462-487
Australia's Great Barrier Reef, Vol. 143, No.6 (June 1973) pp. 727-779
Life Cycle of a Coral Captured in Color, Vol. 143, No. 6 (June 1973) pp. 780-794
Friend of the Wind:The Common Ferm, Vol. 144, No. 2 (August 1973) pp. 234-247
The Friendless Barnacles, Vol. 144, No. 5 (Nov. 1973) pp. 623-669
The Heron that Fishes with Bait, Vol. 145, No. 1 (Jan. 1974) pp. 143-147
Blue-water Plankton, Vol. 146, No. 4 (Oct. 1974) pp. 530-571
Bad Days for the Brown Pelican, Vol. 147, No. 1 (Jan. 1975) pp. 111-123
Diving Amid "Sleeping" Sharks, Vol. 147, No. 4 (April 1975) pp. 570-584
Strange March of the Spiny Lobster, Vol. 147, No. 6 (June 1975) pp. 819-831
The Chambered Nautilus, Exquisite Living Fossil, Vol. 149, No. 1 (Jan. 1976) pp. 38-42
Life or Death for the Harp Seal, Vol. 149, No. 1 (Jan. 1976) pp. 129-142
Adrift on a Raft of Sargassum, Vol. 149, No. 2 (Feb. 1976) pp 188-199
At Home with Right Whales, Vol. 149, No. 3 (March 1976) pp. 322-339
Whales-Imperiled Giants, Vol. 150, No. 6 (Dec. 1976) pp. 722-751
Exploring the Lives of Whales, Vol. 150, No. 6 (Dec. 1976) pp. 752-766
Sponges, Vol. 151, No. 3 (March 1977) pp. 392-408

Oases of Life in the Cold Abyss, Vol. 152, No. 4 (Oct. 1977) pp. 441-454
A Bad Time to be a Crocodile, Vol. 153, No. 1 (Jan 1978) pp. 90-116
Hawaii's Far-Flung Wildlife Paradise, Vol. 153, No.5 (May 1978) pp. 670-691
Dragons of the Deep, Vol. 153, No. 6 (June 1978) pp. 838-845
Palau's Dazzling Corals, Vol. 154, No. 1 (July 1978) pp. 136-150

<u>Texas Parks and Wildlife Magazine</u> Articles

Alligator Holes, Vol. 31, No.5 (May 1973) pp. 20-23
Black Skimmer, Vol. 31, No. 6 (June 1973) pp. 6-9
Many Animales in One, Vol. 31, No. 8 (Aug. 1973) pp. 20-22
Welcome Aboard (Trip to winter home of Whooping Crane) Vol. 31, No. 12 (Dec. 1973) pp. 2-5
Whales, Porpoises and Dolphins of Texas, Vol. 32, No. 1 (Jan. 1974) pp. 12-15
The Toothed Whale, Vol. 32, No. 2 (Feb. 1974) pp. 12-14
Dolphins of Texas, Vol. 32, No. 3 (March 1974) pp. 18-22
Waders be Wary (Stingray), Vol. 32, No. 6 (June 1974) pp. 6-8
Monitoring the Peregrine, Vol. 32, No. 9 (Sept. 1974) pp. 2-5
Terns, Vol. 33, No. 1 (Jan. 1975) pp. 2-5
Clean-up Squadron (Sea Gulls) Vol. 33, No. 2 (Feb. 1975) pp. 2-5
Flatfish, Vol 33, No. 6 (June 1975) pp. 26-29
From the Common to the Bizarre, Vol. 34, No. 2 (Feb. 1976) pp. 16-21
The Great Blue, Vol. 34, No. 3 (March 1976) pp. 6-9
Clown of the Shorebirds, Vol. 34, No. 5 (May 1976) pp. 16-18
Crabs, Vol. 34, No. 8 (August 1976) pp. 2-5
Young Naturalist:Coquina, Vol. 34, No. 8 (August 1976) pp. 28-31
Fish Hawk, Vol. 34, No. 12 (Dec. 1976) pp. 24-26
Long-legged Wading Birds, Vol. 35, No. 2 (Feb. 1977) pp. 12-15
Black Drum, Vol. 35, No. 2 (Feb. 1977) pp. 19-21
Pelican Comeback, Vol. 35, No. 3 (March 1977) pp. 12-15
Young Naturalist:Hermit Crab, Vol. 35, No. 11 (Nov. 1977) pp. 30-31
How to: Set up a Salt Water Aquarium, Vol. 34, No. 2 (Feb. 1976) pp. 29-31
How to: Build an All Glass Aquarium, Vol. 33, No. 6 (June 1975) pp. 20-21

ZONES OF THE MARINE ENVIRONMENT

LESSON FIVE

ACTIVITY ONE

Read -

Zones of the Marine Environment.

Look at -

Diagram of "Zones of the Marine Environment".

Answer -

Questions.

Look at -

Drawings of the abiotic factors in the three zones of marine environment.
Diagram of Nutrients and Salts.
Diagram of Dissolved Oxygen Concentrations

Complete -

The chart of marine zones and abiotic characteristics.

Answer -

Questions.

ZONES OF THE MARINE ENVIRONMENT

The earth can be divided into two types of environments: (1) terrestrial or land environments (2) aquatic environments--fresh and salt water. Look at the sketch "Zones of Marine Environment" profile. The salt or marine environment can be divided into three zones: (1) open ocean--which contains all the ocean waters above the continental shelf and beyond the continental shelf; (2) sea floor--which consists of the floor of the continental shelf and the deep ocean basin and (3) the intertidal or littoral zone--which consists of the zone affected by the tides. Later we shall divide this zone into more areas and look at each. The abiotic factors (the non-living physical and chemical characteristics) of each zone vary.

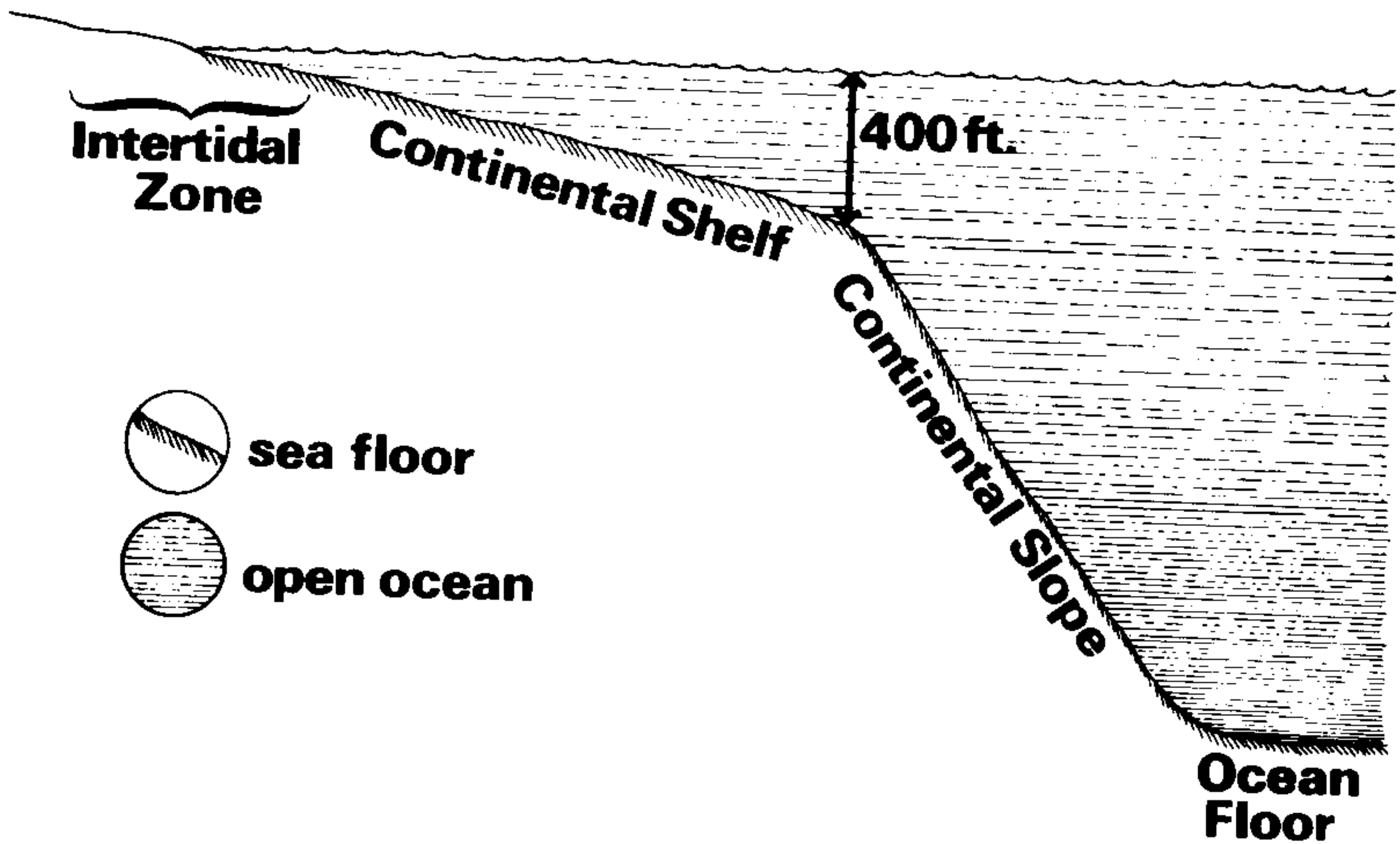
Questions

1. Can you name some abiotic or non-living factors in the marine environment?

2. List some ways the zones are alike.

3. List some ways the zones differ.

ZONES OF MARINE ENVIRONMENT



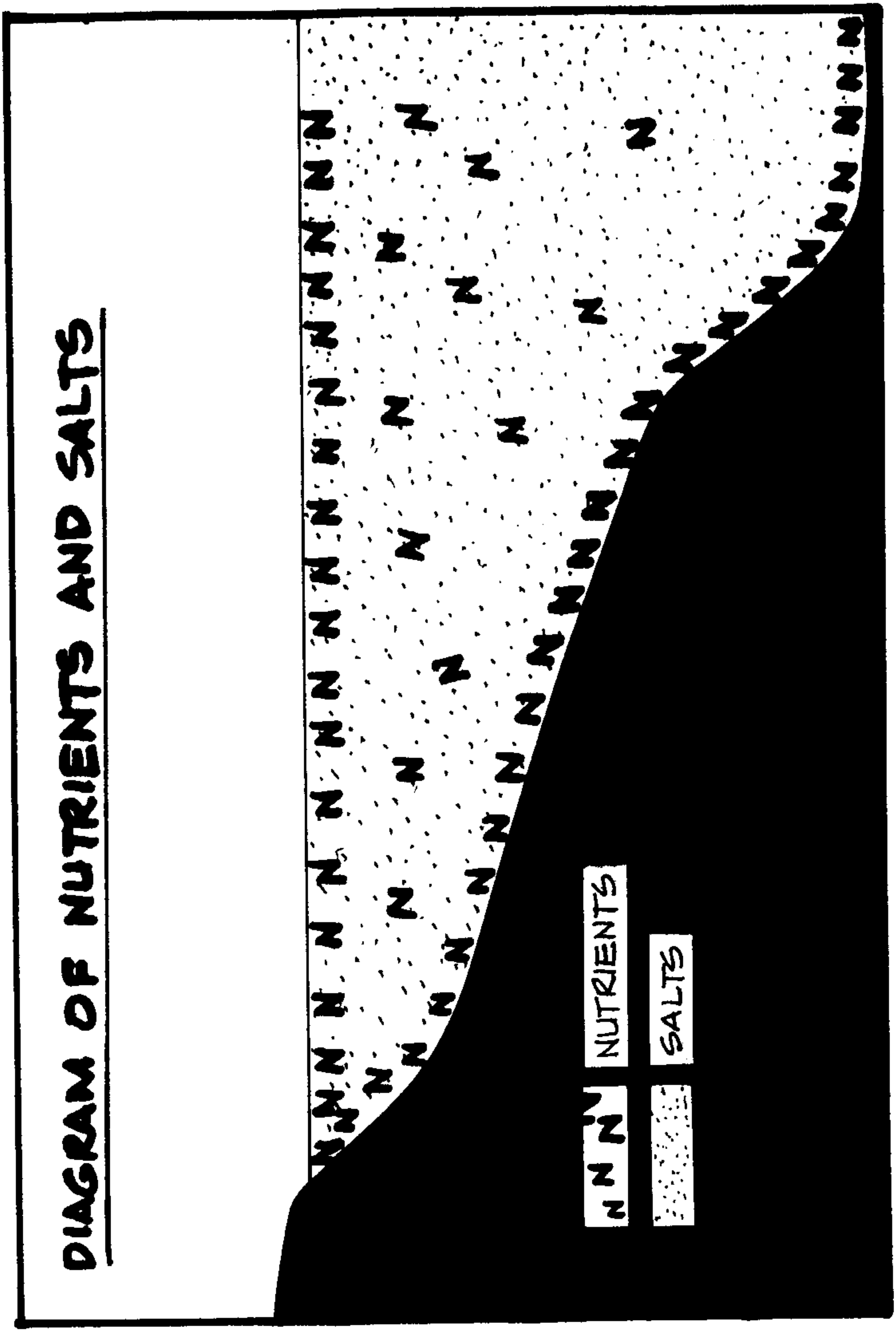


DIAGRAM OF NUTRIENTS AND SALTS
NUTRIENTS
SALTS

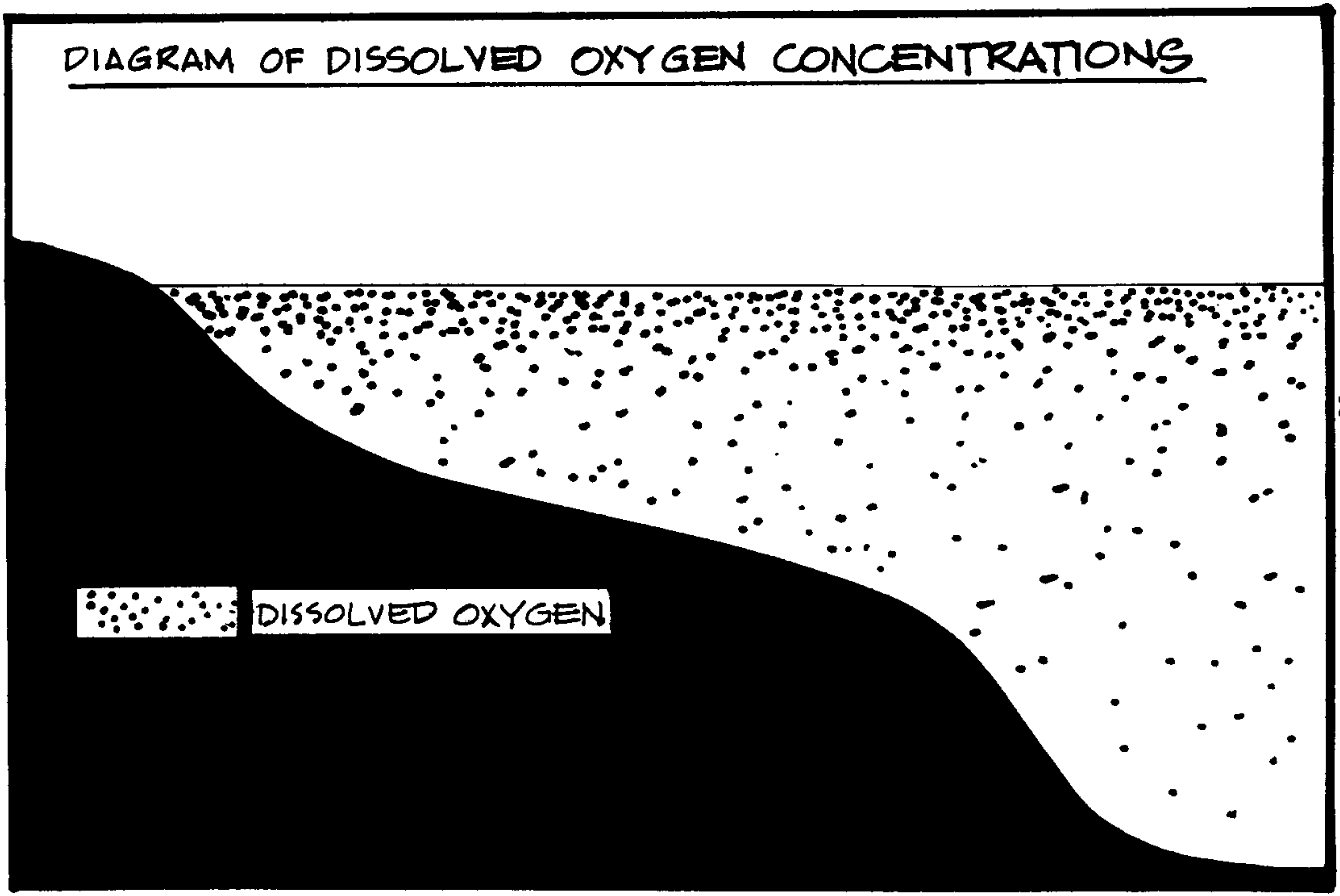


DIAGRAM OF DISSOLVED OXYGEN CONCENTRATIONS
DISSOLVED OXYGEN

CHART OF MARINE ZONES AND ABIOTIC CHARACTERISTICS

Using the diagrams of the abiotic factors fill in the chart below.

MARINE ZONE	LIGHT	SALINITY	OXYGEN	NUTRIENTS	TEMPERATURE
OPEN OCEAN Above continental shelf					More variable than in open ocean beyond shelf
Beyond continental shelf					On surface varies with air-below lighted zone decreases with depth
SEA FLOOR Floor of continental shelf					Similiar to waters above
Floor of open ocean					Similiar to waters above
INTERTIDAL					Varies greatly with tide and time of year

1. What kinds of organisms would you expect to find in each of the zones? Give your reasons.

Answer:

1. Why does the temperature vary greatly in the intertidal zone?

2. How would the temperature variation affect plants and animals of this zone?

3. What would cause the salinity of the intertidal zone and the open ocean above the continental shelf to change?

4. What effect would the amount of nutrients have on organisms? In which zone(s) are the most nutrients found?

5. Would the light have an effect on the kinds of organisms living in a particular zone? Explain.

6. Where is the mostdissolved oxygen found? the least?

7. Would the amount of dissolved oxygen affect the organism? Explain.

MARINE ORGANISMS

LESSON FIVE

ACTIVITY TWO

Read -

The Nekton.
The Plankton.
The Benthos.

Look at -

The sketches of the organisms in each group.

Look at -

The diagram of the distribution of marine organisms.

Divide -

A sheet of paper into five columns.
Label them as follows:
Name of Group
Organisms found in the group
Plants, Animals or both
Locomotive ability
Zones where found

Fill in the columns.

Answer -

The questions on the groups of marine organisms.

Add -

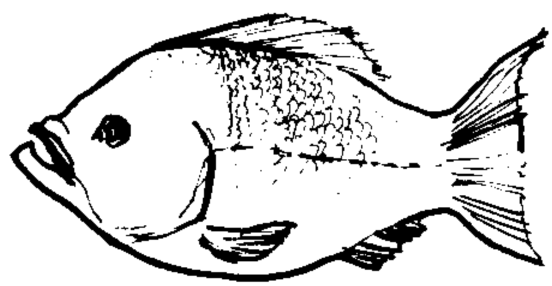
Representatives of the three groups of marine organisms to your mural of the ocean floor. You may draw the pictures, find pictures or cut out and color/paint pictures from the sketches of organisms in each group. Make sure that you place each organism in its proper zone.

Groups of Marine Organisms

All life in the sea is grouped into three basic groups according to their locomotive ability and mode of living. These groups are the nekton, benthos, and plankton. I would like to introduce you to each group by asking a member of that group to tell up about their group.

The Nekton--by Charlie Fish

Hi! I'm Charlie Fish. I am a representative of the group of organisms called NEKTON. There are no plants in our group. We are strong swimmers,so we can move freely from place to place. The ocean currents or tides do not effect us. We are numerous in surface waters where food is abundant. We are not evenly distributed in the ocean but are found where our food is abundant. We decrease in number as you go deeper into the Gulf. Other members of the group besides us fish are the marine mammals (whales, porpoises, dolphins, and seals), sea birds, reptiles (turtles) and cephalopods, such as the squid. We can chase our food, flee if endangered, and cover large areas of water in our migratory journeys. However, our size, habit of gathering in schools, and our abundance over the sea make us the most important marine food resources available for harvesting by man.



The Plankton by Phyllis Plankton

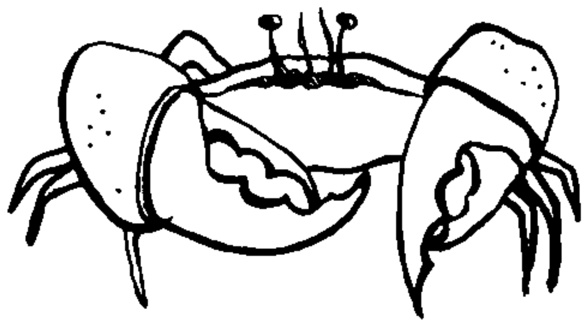
Hi! I'm Phyllis Plankton. We plankton exist in nearly every natural body of water throughout the world in such large numbers that we cannot be counted. We are mostly microscopic, but we are the most important organisms of the marine world. All forms of life either indirectly or directly depend on us. We wander or drift under the influence of the ocean currents and tides Although many of us have the ability to swim, our efforts in the presence of ocean water movements are usually too feeble, therefore useless.

We can be divided into two groups: the phytoplankton and zooplankton. Phytoplankton means plant plankton. There are two main groups of phytoplankton: diatoms and dinoflagellates. All of us phytoplankton require sunlight to produce food, so we must live in the upper layers of the sea. We produce plant food and without us none of the animals of the oceans could exist. We also produce 70% of the oxygen in the world's atmosphere. We may be very small, but without us, there would be very little life on earth.

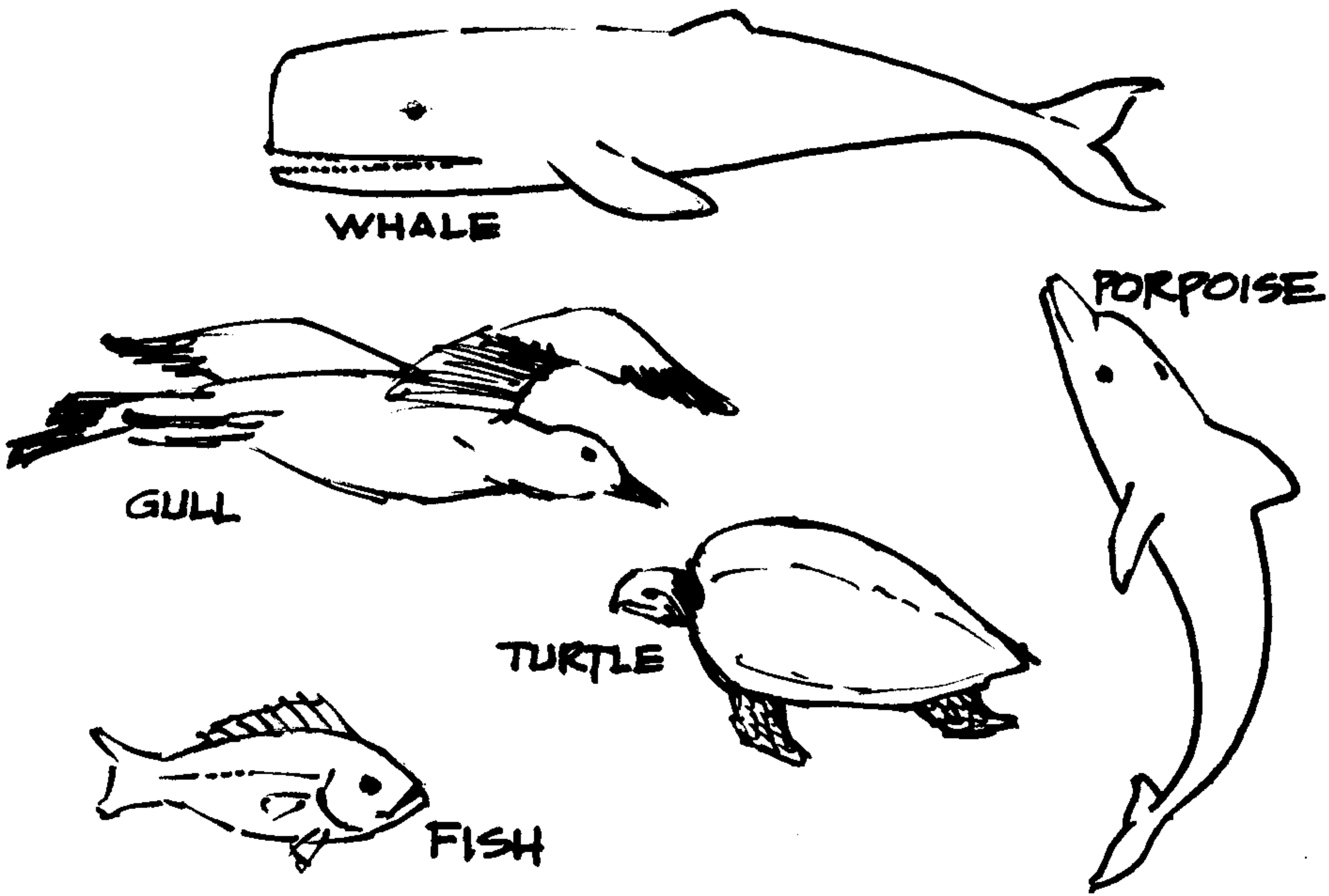
We, zooplankton or animal plankton, are strangely shaped with representatives from every major group of marine animals. We must stay in the upper layers of the sea to obtain food. Some zooplankton feed on phytoplankton while some eat each other. We are composed of temporary and permanent members. Our permanent members are those of us who spend our entire lives as plankton. These are the protozoans (formanifera, radiolarians, tintinnids) siphonophores, ctenopheres, some rotifers, and crustaceans which are the most abundant. Our temporary members are those who only spend part of their life as drifters. They are the larvae of sponges, corals, worms, mollusks, echinoderms and fishes. When they become adults, they become either the nekton or benthos.

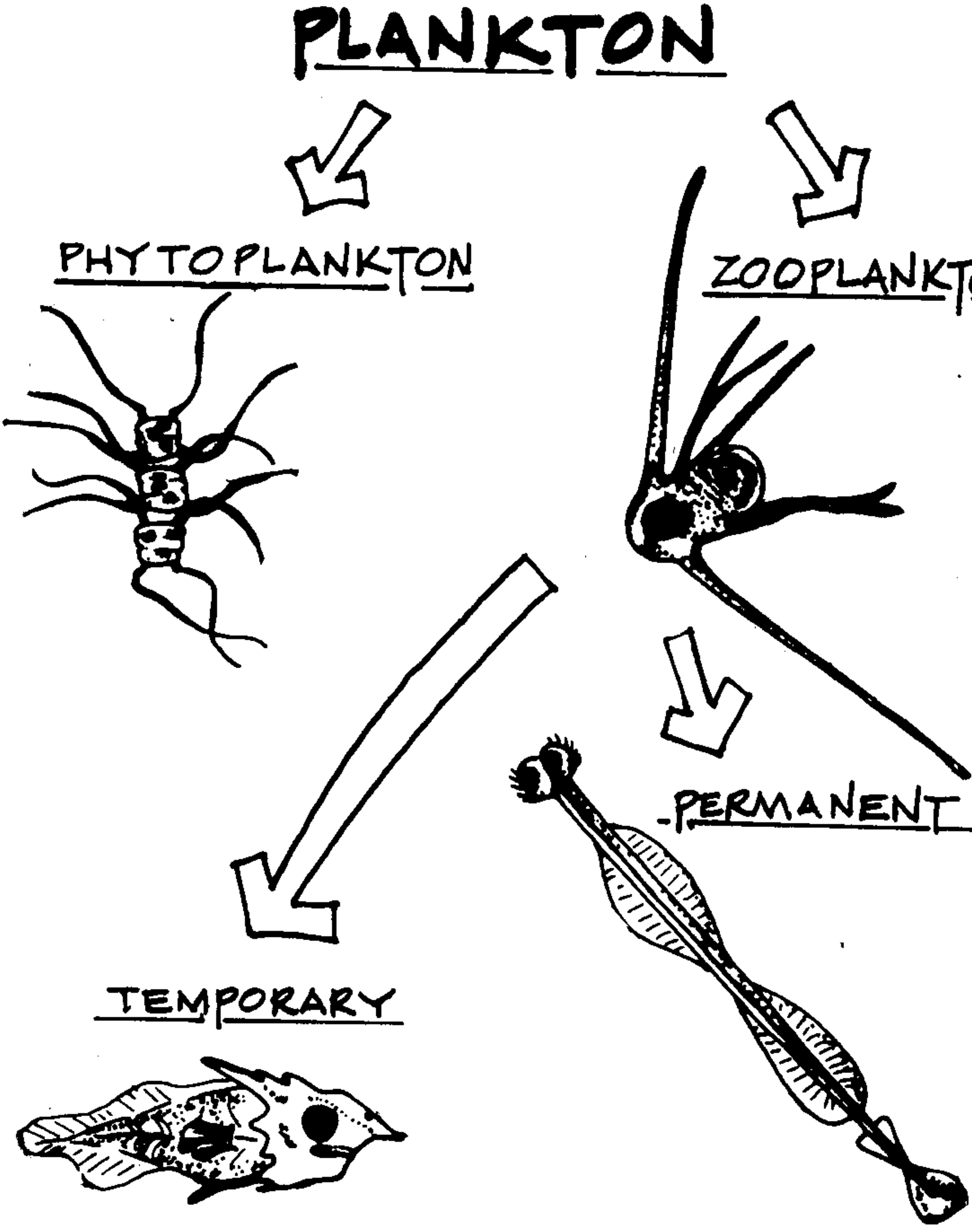
The Benthos by C. Crab

Hi! I'm C. Crab. I am a representative of the Benthos group. We live on the bottom. Our group has both plants and animals. Temperature, dissolved oxygen, depth of bottom and the kind of bottom (mud, sand, rock) determines which one of us you will find in an area. Some of our group remain attached to the bottom like the sponges, barnacles, oysters, mussels, corals and bryozoans eel grasses and the sea weed (algae). Some of our group creep or crawl along the bottom like me, other crabs, isopods, snails, shrimp, some bivalves, crustaceans, but not plants. Some of our group burrow into the sediments like most clams, worms, some crustecea, and echinoderms. At present not much is known about those of our group who live on the bottom of the deepest parts of the ocean. We know that worms, sea cucumbers, shrimplike creatures and brittle stars exist on the bottom at all depths.

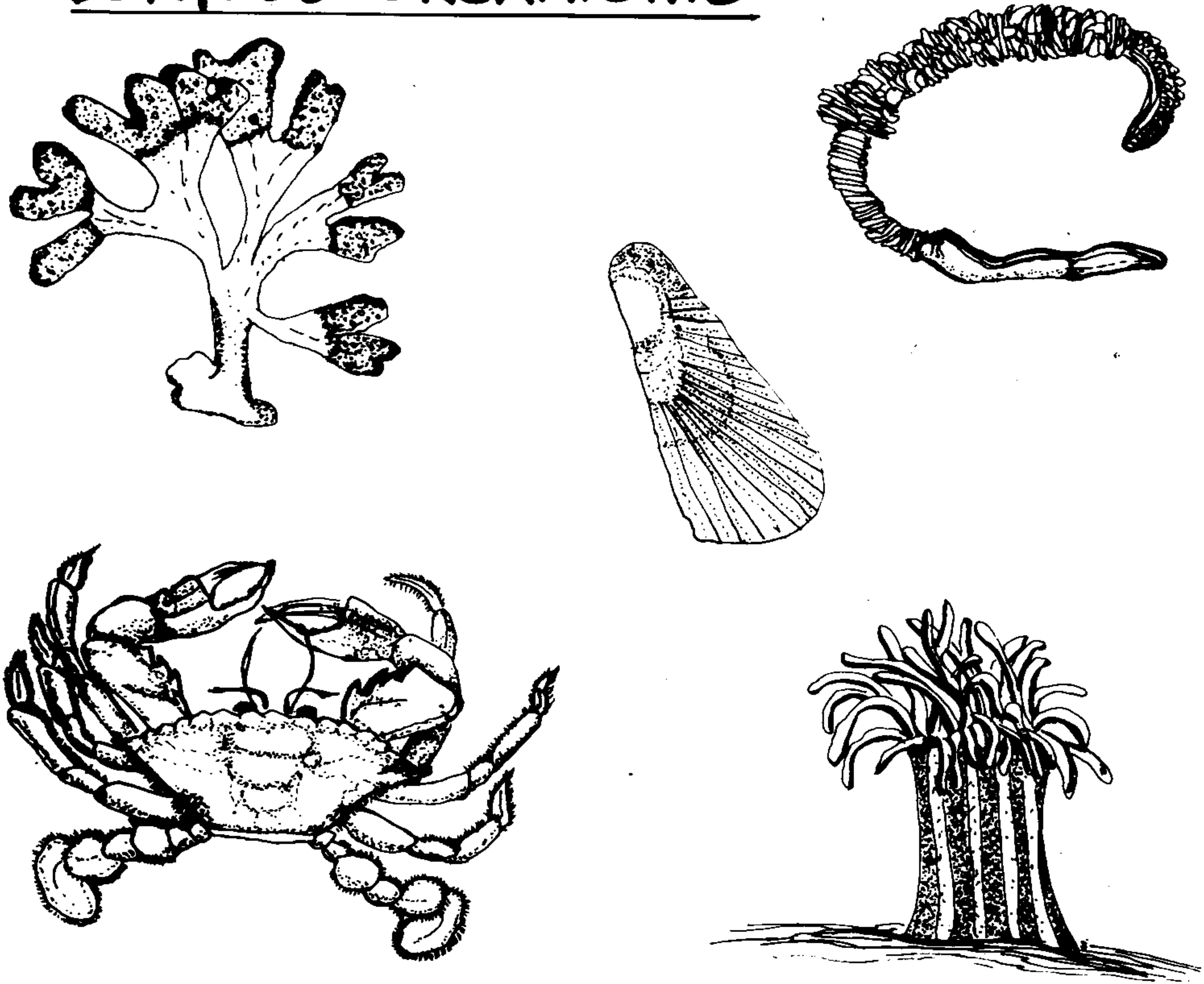


NEKTON ORGANISMS

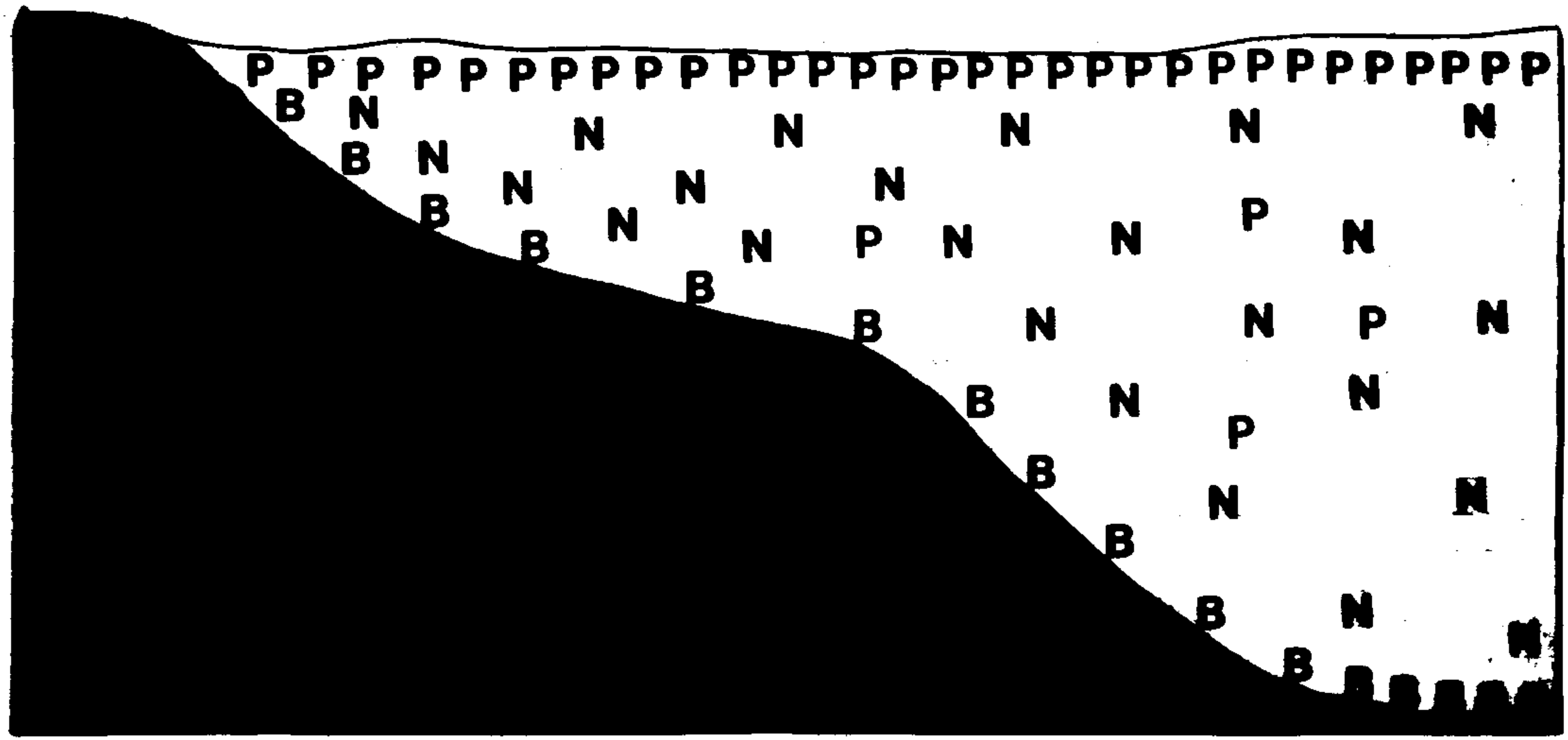



PLANKTON
PHYTOPLANKTON
ZOOPLANKTON
PERMANENT
TEMPORARY

BENTHOS ORGANISMS



KEY
P-Plankton
N-Nekton
B-Benthos



Questions on the distribution of marine organisms.

You may wish to refer back to the diagrams of abiotic factors, zones of marine environment, distribution of marine organisms, and your chart to help you answer these questions.

1. Which organisms are found in more than one zone?

2. Why are the plankton found in the surface waters?

3. Where do you find the benthos? Why?

4. How does each group get its food?

5. If we dredge the bottom of the shelf which group is affected?

6. Why could the plankton be called the smallest but mightest?

INTERTIDAL ECOSYSTEMS

LESSON FIVE

ACTIVITY THREE

Look at -

Aerial sketch and the profile sketch of the areas of the intertidal zone.

Look at -

Sketches of the intertidal ecosystems.

Read -

Marine Ecosystem.
Rock, Jetties and Groins.
Sandy Beaches.
Oyster Reef.
Salt Marshes.
Mud Flats.
The Water, Itself.

List -

Some examples of biotic factors in an ecosystem.

List -

Some examples of abiotic factors in an ecosystem.

Prepare -

An interview or skit with some of the organisms in each area of the intertidal zone to present to the class. Include in the interview or skit information about the:

(1) abiotic factors
(2) biotic factors
(3) interaction between the biotic community and the abiotic factors

Present -

Skit or interview to the class

<u>Optional</u>
Add -

The intertidal zone and organisms found in each to your mural.

<u>Optional</u>
Complete -

Let's Get Aquainted Activity.

<u>Otional</u>
Write -

A syntu about a marine organism.

Share -

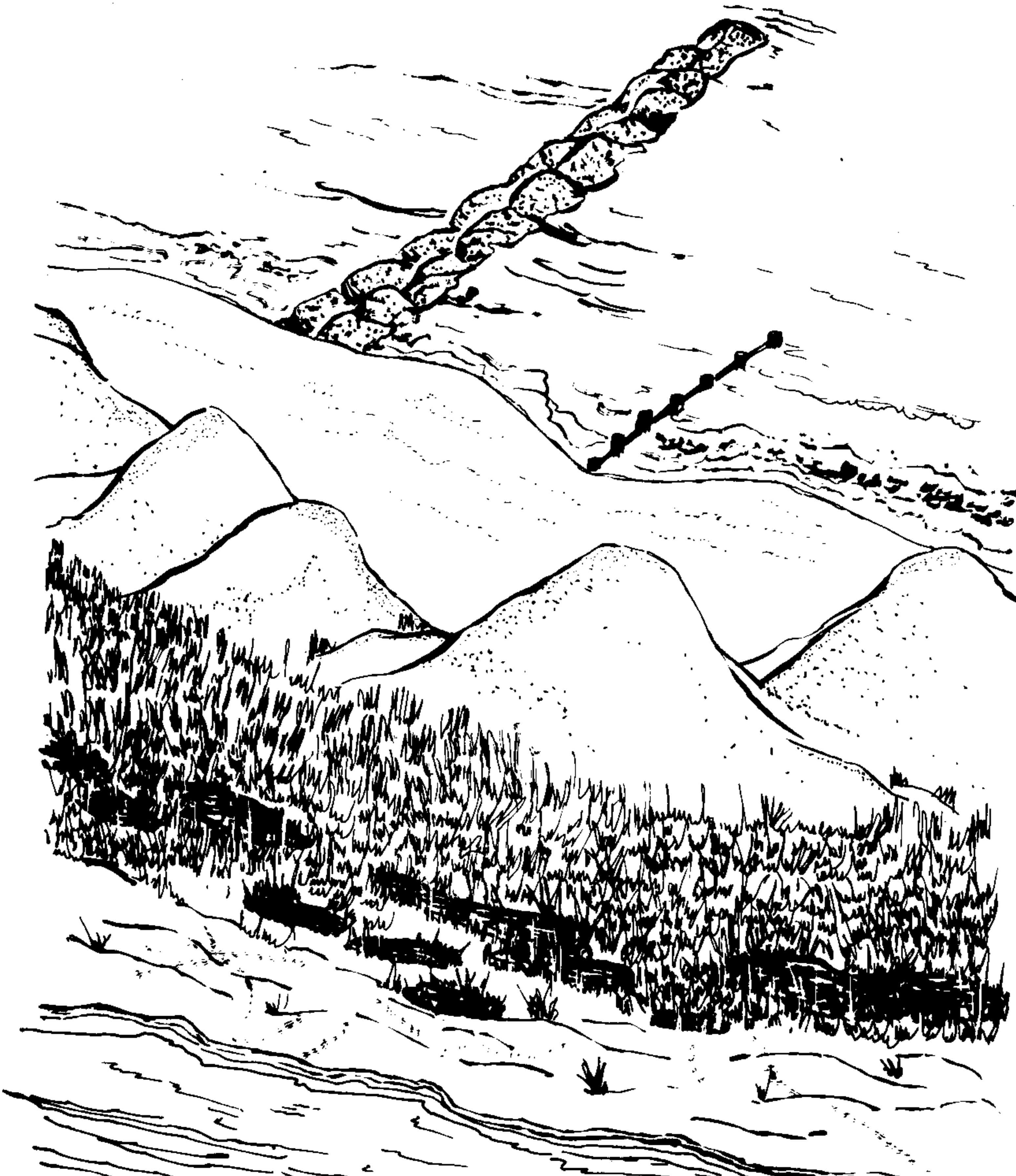
Syntu with your classmates.

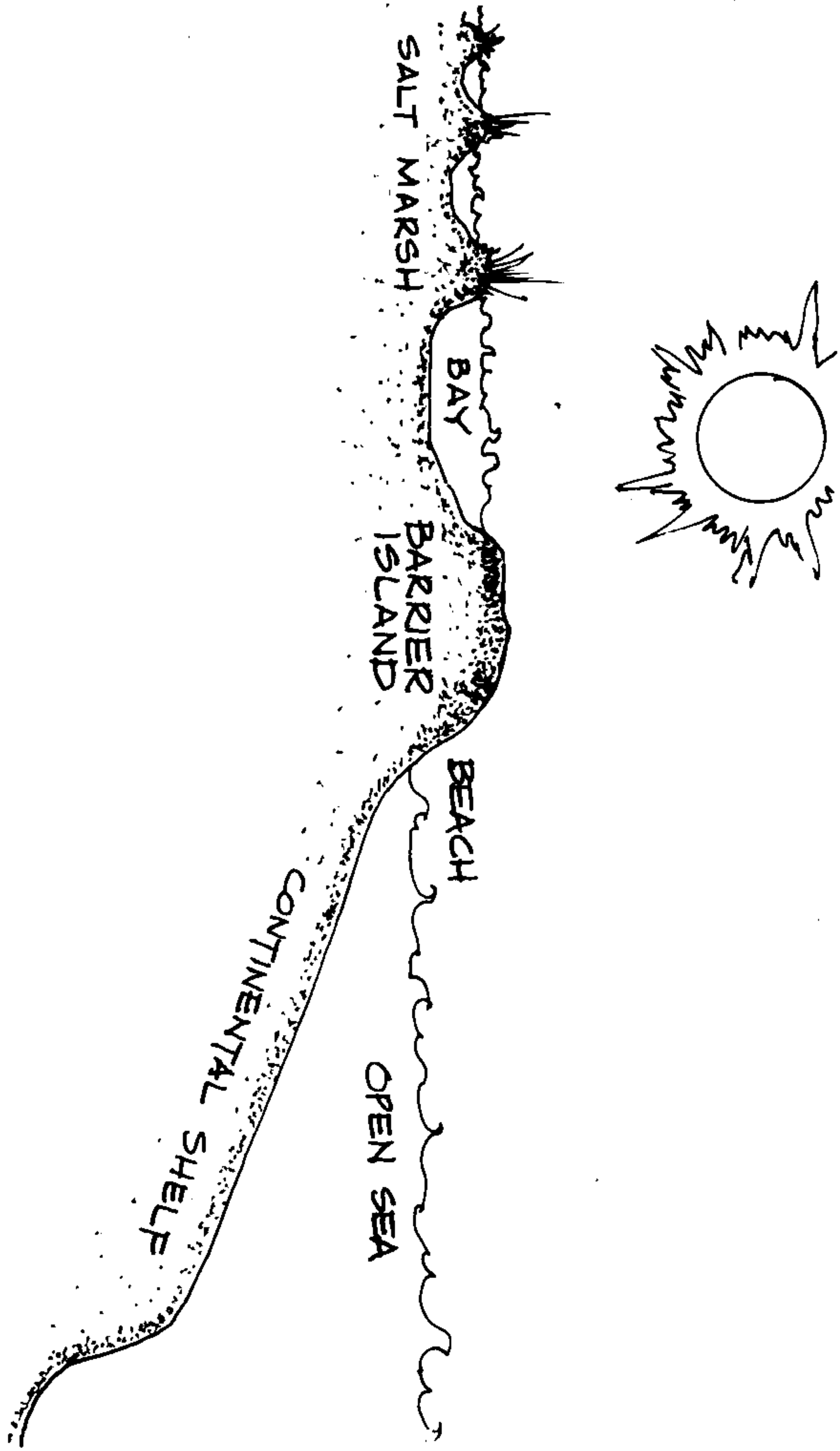
<u>Optional</u>
Read -

An article on a marine organism.

Report -

On the marine organism you read about.




SALT MARSH
BAY
BARRIER ISLAND
BEACH
OPEN SEA
CONTINENTAL SHELF

MARINE ECOSYSTEMS

The land environment as well as the marine environment is composed of many ecosystems. Ecosystems are the interaction of the living organisms (biotic) and non-living physical and chemical factors in a particular location.

The intertidal zone consists of numerous marine environments. If we look at the map of the Gulf of Mexico along the Texas coast, we see a series of barrier islands enclosing shallow bays. These form environments which differ in their characteristics and variability. We shall separate these into the following ecosystems: rock jetties and groins; sandy beaches; bayshores--salt marshes, mud flats and the water itself.

ROCKS, JETTIES AND GROINS

Many areas have rocky shores, but on the Texas coast there are no natural rocky areas. However, the Texas rocky shores are jetties and groins that were made by man to control the movement of sand along the shore.

This is the only area with a solid subtrate where algae (seaweed) can grow. The marine algae is rather limited, possibly because of the predominately sandy and muddy shore and the great variations in temperature and salinity. The red algae are greatest in abundance and number of species, and then the green algae. Brown algae, such as kelps, are absent and only a few other brown algae are found. If it were not for this man-made environment, there would be very few algae.

The animals on the jetties include the acorn barnacle, zebra periwinkle, false limpet, rock louse, hermit crab, stone crab, porcelain crab, the drill sea anemone, peppermint shrimp, sea hare, sea urchin, beach flea, hydroid, stony coral, fan worm, jackfish and spadefish.

Most of the animals on the jetties either filter plankton from the water, eat algae or diatoms that grow on the rocks, or search for scraps of food left by the tide, gulls, or fishermen,

The jetty environment requires hardy individuals to survive its harsh conditions. They must survive the stress of: (1) breaking waves and sand, (2) strong currents, (3) changing tides, (4) sudden changes in temperature and salinity,and (5) exposure to the sun and wind.

The jetty inhabitants do have common features with other rocky shore organisms around the world. They live in definite vertical zones. There is, for example, the splash zone which is wetted only by the spray of the breaking waves, or the zone only uncovered by low tides. These and the other zones are similar wherever there is a rocky shore.

ROCKY SHORE

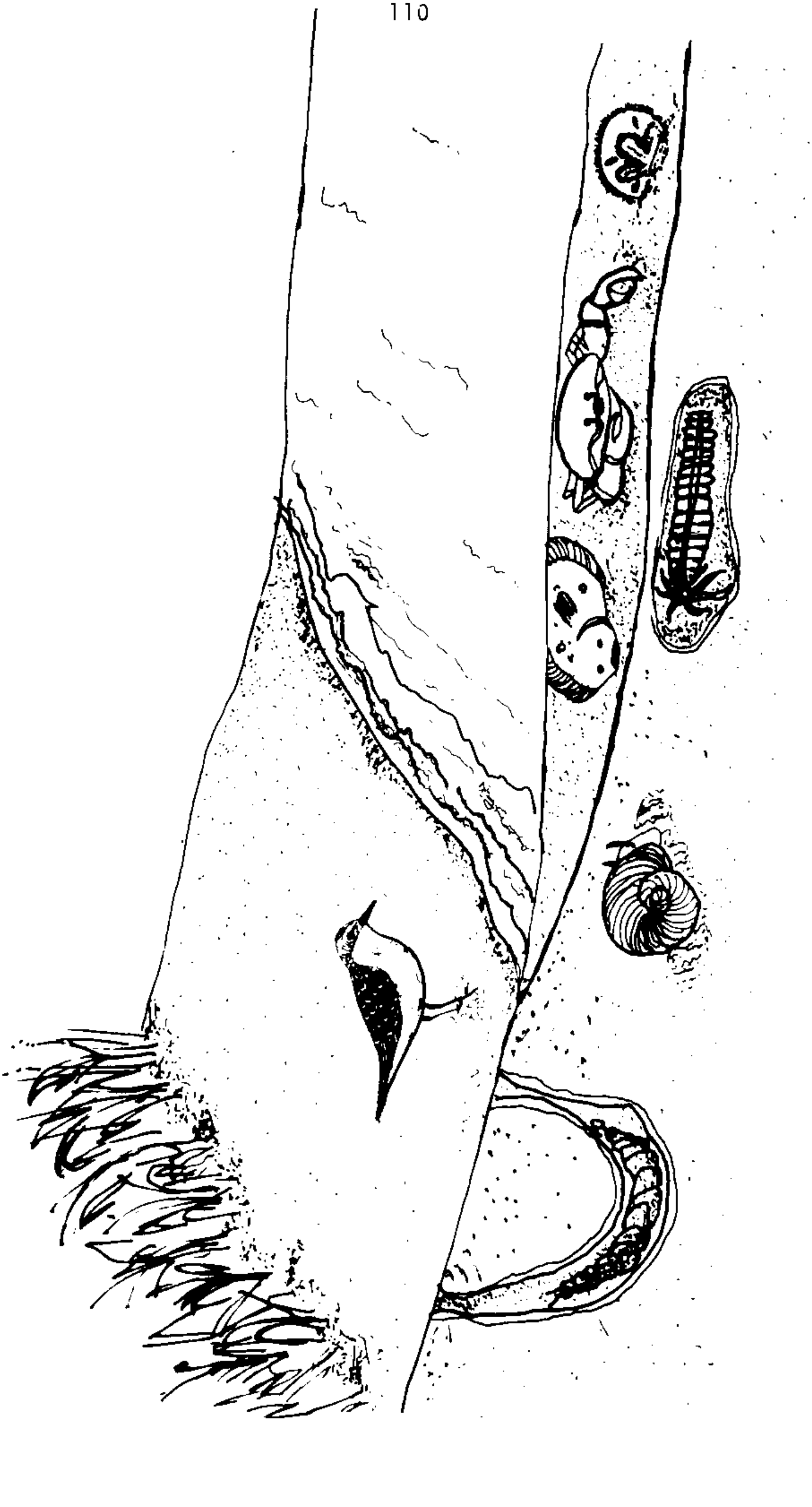
SANDY BEACH

The beach is also a harsh environment for organisms. The factors they must deal with are pounding surf, abrasive sand, periods of wetness and dryness, temperature changes and, exposure to the sun. Most sandy beach animals escape physical inhabitants of their environment by burrowing. So much of the community lives underground out of sight. Some species move up and down the beach with the tide.

The beach can also be divided into vertical zones. In the zone of the dunes to the high tide level we find the plants: silvery beach croton, waving sea oats, railroad vine, sea purslane, yellow beach evening primrose, and others. In this area some of the animals are the ghost crabs, tiger beetles, rattlesnakes and lizards, spotted ground squirrels, kangaroo rats, grasshoppers, mice and other rodents like gophers and rats. The zone between the tides (littoral-high and low tides) is inhabited by the bean clam, mole crab, lettered olive and moon snail, hermit crab, auger shell, and tube building worms.

In the zone below low tide level (sublittoral) we find the sand dollar, Scotch bonnet, starfish, sea star, sea pansey, yellow and purple sea whips, calico crabs, blue crabs, and other crabs, murex, banded tulip, clams, many species of shrimp, octopus, and fish such as trout, redfish, drum, gaftop, pompano, croaker, and others.

SANDY BEACH



THE OYSTER REEF

The oyster reef community is an important biotic community in the bays. The commercial oyster is found in almost every Texas bay. None live in Laguna Madre, but scattered reefs exist in South Bay near Port Isabel.

The reef is more than a collection of oysters. It is a community of many plants and animals. Other animals use the reef as a hiding place, a source of food, or both. These plants and animals attract small fish. The small fish attract larger fish and these, in turn, attract the fisher-man.

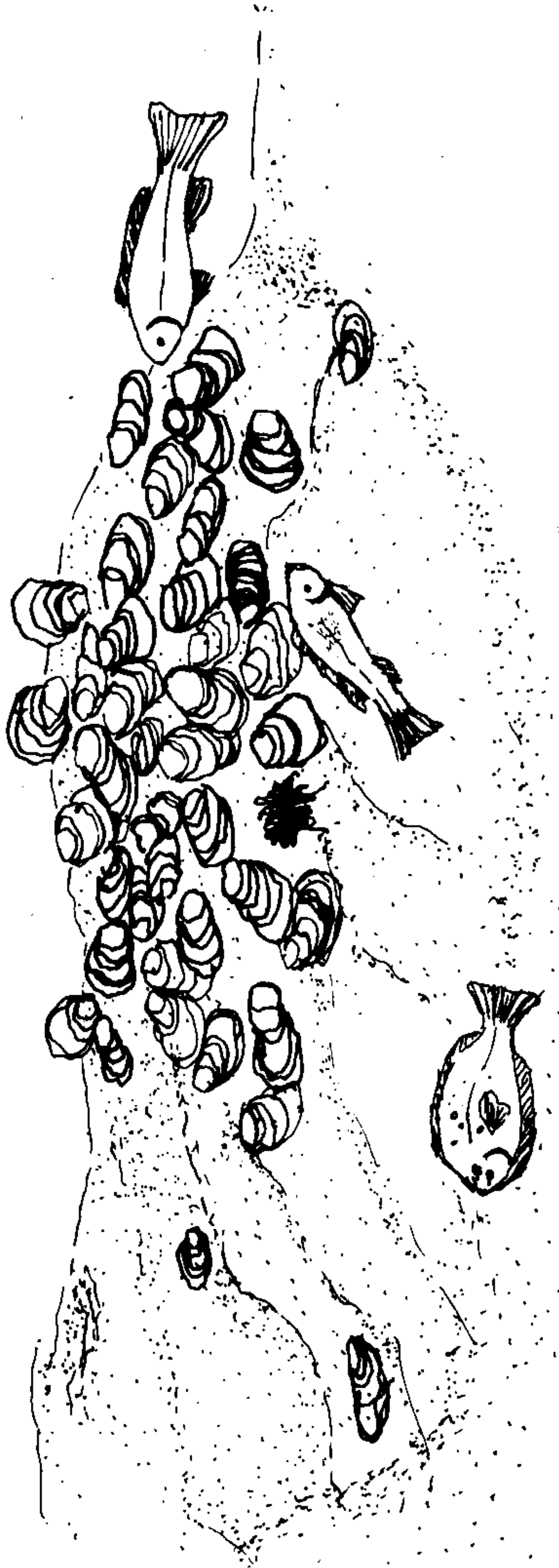
Oyster reefs are groups of living animals growing on the graveyard of their ancestors. They form very slowly over a long period of time. The life of the reef is related to the organisms forming it. When they die the reef also dies and becomes buried in the mud. Whenever the conditions fa-vor the growth of oysters, a reef may be formed. Firm bottoms of sticky mud, clay, sand, or gravel are needed. At first a few oysters attach to the bottom. The next generations attach themselves to these oysters and the dead shells. A reef forms. The formation of the reef depends on the direction of water currents. The oysters depend on these currents to bring in their food, the plankton. The oysters nearest the current, therefore closest to the food, grow fastest and are first reached by larvae. The reef grows facing the current.

Oysters grow very well where the fresh waters of streams mix with the salt water of the Gulf. So they are found in the bays or tidal rivers. They can survive a wide range of salinity from fresh water for brief periods, to waters saltier than the Gulf. Freezing temperatures will affect the oyster if it is exposed in shallow water. Temperatures over 90°F for a long period of time weaken the oysters. The greatest hazard to the oyster reef is the settling of clay or mud. A small amount may interfere with the feeding, and large amounts will smother and bury the reef.

Some members of the reef community are competing with oysters for food or places to attach. These are the mussels, anemones, barnacles, slipper shells and the serpulid worm.

Many inhabitants of the reef are oyster predators like the drills, the stone, blue and mud crabs, flatworms, snails and boring sponges. Some animals like small snails, porcelin and oyster crabs, sea squirts, and pen shells use the reef as a shelter .

OYSTER REEF



SALT MARSHES

A wedding of the land and the sea gives birth to the salt marsh. The marsh begins to form when waves shape sand into offshore barriers. Tidal creeks cut through these protective barriers, flooding the area behind them daily with seawater. In this area, protected from the battering waves, cordgrass grows. Its dense growth slows the tidal currents so they drop their load of material to form a floor of nutritive mud.

The salt-tolerant grasses of the marsh produce vast amounts of organic material by photosynthesis. The salt marshes are among the most organically productive areas on earth. Only tropical rain forests, coral reefs and some algal beds produce more. The best farmland produces only half as much life as the salt marsh.

The salt marshes fed by both salt and fresh water are the nurseries for many marine organisms as well as nourishing myriad creatures of sea and land. Nearly all commerically valuable seafood owes its existence directly to the marsh. So this ecosystem is a factory for human food.

The stands of cordgrass are a prominent feature of the salt marsh. Many animals seek refuge on and among its sturdy stalks. One of the most abundant is the marsh periwinkle which climbs the cordgrass to escape the rising tide. When the tide recedes, it descends and crawls about on the mud grazing on plant matter and other detritus. The marsh snail horn shell, mussels and worms are also in the mud at the base of the cordgrass. The stone crab is present, cracking open clam, snail and hermit crab shells for a meal.

The fiddler crab sifting through the mud and sand for edible material, is one of the most common crabs in the salt marsh. The marsh crabs, pulmonate snails and amphipods also use the debris for food. Land crabs are present in the salt marsh.

The tidal creeks of the marshes are the nurseries for the young of many species of Crustacea (shrimp) and crabs and fish. Some species of fish spend their entire life in the area while in other species only the young do. Phytoplankton, plankton, and planktonic larva are also present. The grasses, phytoplankton, and mud algae are the key producers of the salt marsh.

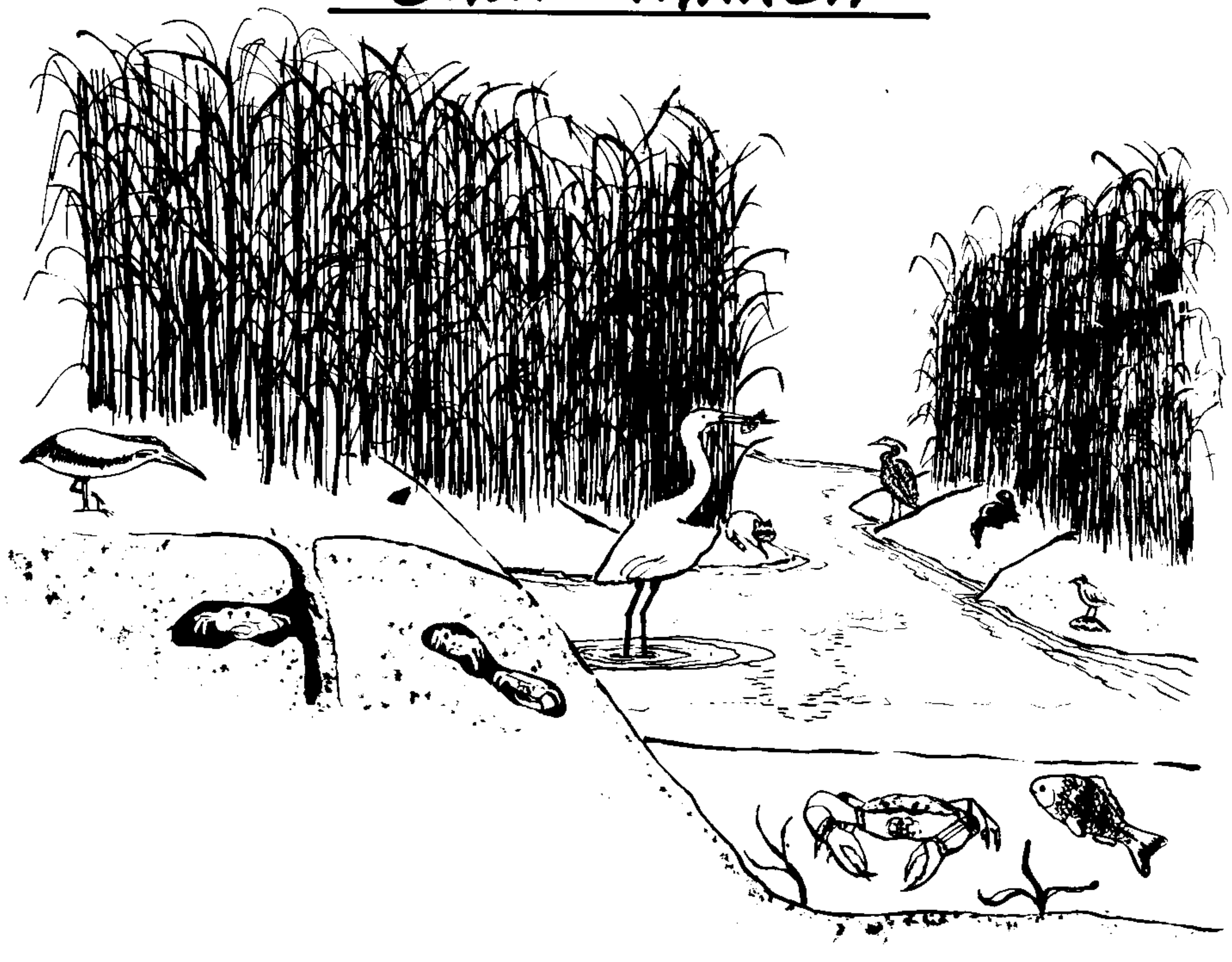
Among the marine animals, only a relatively few can adjust to the rapid salinity changes which occur in the salt marsh. The marsh vegetation supports many migrants. This includes such mammals as the opposum, mouse and the raccoon who visit the water's edge to eat mussels and crabs. The muskrat is a permanent resident in the less saline parts where its food, such as bulrushes and cat-tails, is abundant. The deer also visits the marsh to graze.

The diamond back terrapin lives in the marsh. It feeds on dead fish, marine worms, fiddler crabs and small mollusks.

Many species of birds may be found in the salt marshes. However, only a few species are characteristic of the salt marsh and either reproduce there or closely frequent it. The common ones are certain rails, sparrows, ducks, teals, certain shorebirds, marsh hawk red-wing blackbird, marsh wren, herons and bitterns.

The salt marsh is where the incoming tide stirs up nutrients and recharges stagnant pools with oxygen. Organisms ride in with the tide to feed. As the tide recedes, it flushes out dissolved material and carries decaying plant material as well as living plants and animals to join the offshore food web. Birds move in to eat creatures left exposed on the mud. This makes the salt marsh a cradle of life for an estimated 95 percent of all fish and shellfish landed by sport and commercial fisherman along the Gulf coast.

SALT MARSH



MUD FLATS

Large areas of the shallow Gulf coast bays are covered by only a few inches of water at low tide. These areas are too shallow for the forming of salt marshes. These are the mud flats. They are not flat however, the bottom is shaped by currents, waves and burrowing animals.

The mud flats are often exposed during extreme low tides and northers. Therefore, they are best suited for burrowing organisms or very motile ones. The organisms also vary from one area to another since the bottom varies. Near the passes and in channels cut by currents, the bottom is sandier.

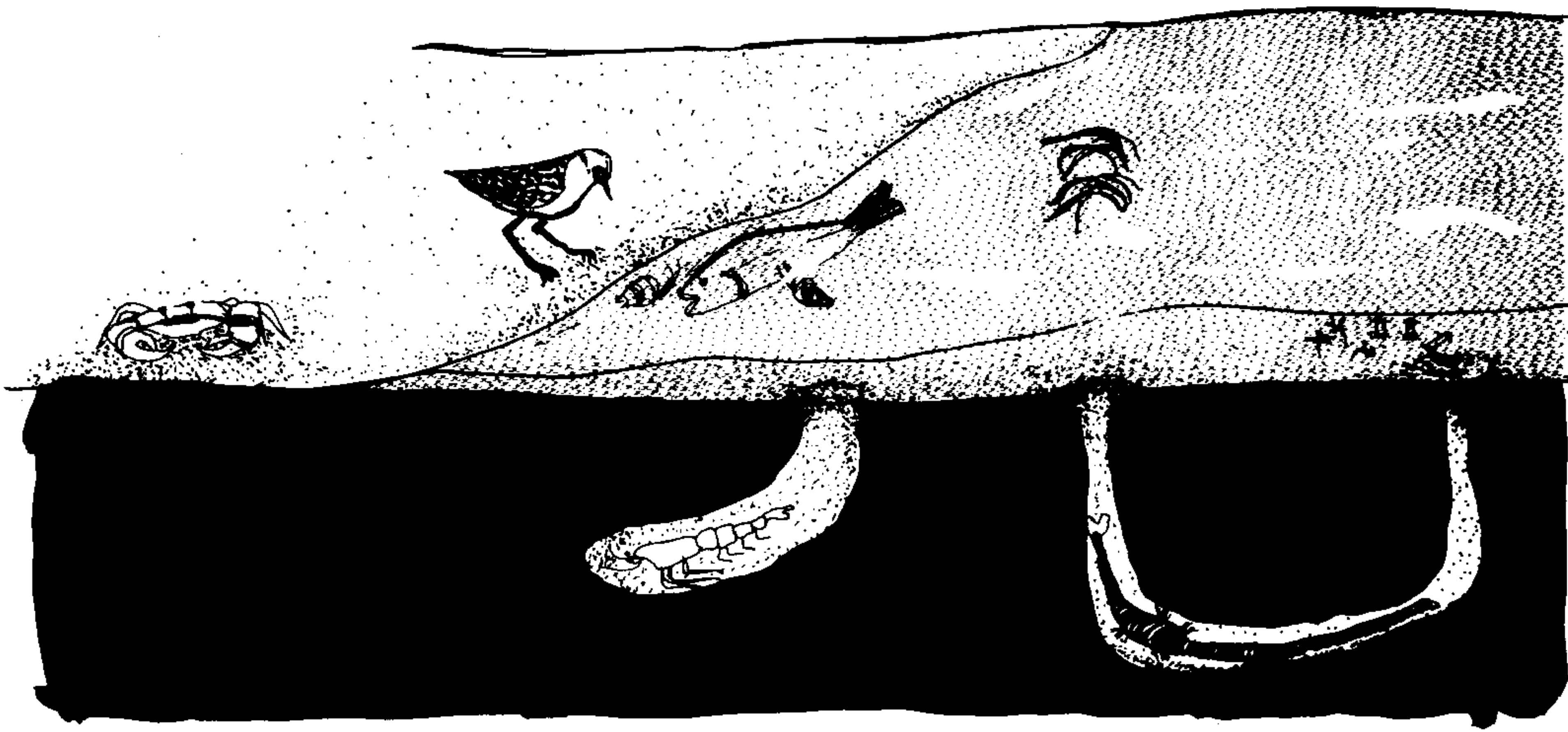
In the sandy mud there is the stout razor clam who is a deposit feeder. Its enemies include the drill, the blue crab, the hermit crab and various shorebirds. There are also the jackknife clam and the fragile angel wing. The common rangia is a true estuarine animal since it is found well into the months of rivers and bayous. There is also the dwarf surf clam which is eaten by bottom-feeding fish. The constricted macoma and southern quahog are two clams that are also in the mud flats along with mud shrimp and ribbon worms.

The mud crab, mud flat crab and large stone crabs are at home in the mud flats. The burrows of the large stone crabs play an important role in the mud flat ecology. During low tide these burrows provide the mud crabs, hermit crabs, grass shrimp, snapping shrimp, worms and several species of fish a shelter from the drying sun and foraging shorebirds.

In the sandier mud flats, near the passes, there are the bright red nemertean, moon snail, babv's ear, the common mud snail, common Atlantic auger, and the oyster drill. There are also three species of hermit crabs. Many polychaete worms as well as the parchment worm and lugworm are at home in the mud flats.

There are also submerged beds of widgeon grass on the mud flats. This grass helps to stabilize the sediments and provide food and shelter for organisms. Some of these organisms are the grass, arrow and snapping shrimp. Another grass community in the mud flats is the turtle grass. In the turtle grass there are pink and grass shrimp, mud crabs, thick lucine cross-barred venus, and the bay scallop. The sea cucumber, virgin nerite, whelks, tusks and bubble shells are also found in the mud flat areas.

MUDFLAT



THE WATER, ITSELF

The water itself forms an additional community for swimming and floating organisms, in the bays, passes, and beach water. These include plankton and nekton. The plankton change with the seasons since they are very sensitive to minor changes in temperature, salinity, oxygen level or toxin in the water. The larvae of most marine animals are plankton and so are usually seasonal in their appearance.

Some of the permanent plankton are the copepods, etenophores, arrow-worms, and sergestid shrimp. Some of the larger plankton are the cabbage heads, moon and other jellyfish, sea nettle, sea wasp, and sea walnut. Other animals such as spider crabs, and blue crabs may hitch rides in the jellyfishes' bells.

The most obvious invertbrate nekton are squid and the shrimps and swimming crabs. The majority of the nekton are the fishes, but there also are the sharks, rays, skates, and dolphins.

The waves washing up on the beach often carry organisms which normally live in deeper water or drift out in the Gulf. Some of these are the Portuguese-Man-of-War, and purple storm snail. Most of these are usually dead or battered. The flotsam (driftwood or non-living objects afloat) carry several species. These are the stalked barnacles and boring clams. Sargassum, a floating seaweed, is brought in by the currents also, and washes on the beach. The sargassum brings with it many animals who live in its branches. These include hydroids, anemones, flatworms, polychaetes, shrimp, crabs, nudibranch, sargassum fish, and the young of other fish.

OPEN WATER

LET'S GET ACQUAINTED

Select a marine mammal.

Draw the marine mammal's face in the space below. (Dolphins, walruses, manatees, seals or whales may be good examples.)

Now draw a series showing how some of these marine animals swim or move, like: a surfacing whale, diving walrus, or a jumping dolphin.

Make the drawings cartoon-style (in the sequence below) so you can visualize the movement. Don't forget to add in the natural marine environment around the animal.

SYNTU ABOUT A MARINE ORGANISM

Write a syntu about a marine organism. A syntu is a Japanese poem consisting of five lines. The lines are as follows:

In line 1 use one word--the name of a marine organism.

In line 2 write an observation of the marine organism you named in line 1 using one of the five senses.

In line 3 write a feeling about the item named in line 1.

In line 4 write another observation of line 1 using one of the senses not used in line 2.

In line 5 write a one-word synonym for line 1.

Write your syntu below.

LESSON SIX
EVERYONE BELONGS (ENERGY RELATIONSHIPS)

ACTIVITY ONE-Producer, Consumer...
ACTIVITY TWO-Who's For Dinner?
ACTIVITY THREE-Who-Eats-Whom Chain (Food Chain)
ACTIVITY FOUR-The Big Web
ACTIVITY FIVE-It's a Pyramid!

Suggested Time for Classroom Use of Materials: Approximately 7 to 9 class periods

Materials for Classroom Use:

Producer, Consumer.../reading
*Marine Organism/card deck
*Who's For Dinner?/instructions
Sketches of the marine ecosystems from Lesson Five
Jetties and Groins
Sandy Beach
Mud Flat
Salt Marsh
Oyster Reef
Water, Itself (Life on Continental Shelf)
Who-Eats-Whom Chain/reading
*Who-Eats-Whom/instructions
The Uninvited Guest/reading
Food Pyramid/reading
It's a Pyramid/sketch
Make a Dolphin/instructions
Make a Dolphin/game board and cards
Managing a Small Bay/activity
Food Web of Bay/sketch
Scissors
Glue
Heavy paper

*Idea from PREDATOR the food chain game
Ampers and Press
2603 Grove Street
Oakland, Ca. 94612

Major Objectives for the Lesson: After completing the lesson the student will be able to:

1.1 if given an ecosystem, to point out the producers, consumers, and decomposers;

1.1 define and give examples of producers, consumers, decomposers, herbivores, carnivores, and omnivores;

1.1 define food chain, food web, and food pyramid;

1.1 classify organisms into categories of herbivores, carnivores and omnivores;

1.3 construct model food chains;

1.3 diagram the energy flow from the sun to man;

1.3 conclude that the food chain is the transfer of energy from the source in plants through a series of organisms repeatedly eating and being eaten;

1.3 compare and contrast land and marine food chains;

1.3 make inferences as to what would happen to the food web if all plants were destroyed;

1.3 make inferences as to what would happen if certain animals in the food web were killed;

1.3 interpret as to what happens to the mass (nutrients) and energy as one moves up the food pyramid.

1.3 conclude that not only is energy being transferred in a food web or food pyramid but a host of nutrients as well and although there is a progressive decrease of energy in this trophic or feeding chain, the nutrients are not diminished;

1.3 identify what group of organisms the food pyramid indicated as being the least numerous and the most numerous;

1.3 explain and diagram a food chain, food web and food pyramid;

1.3 recognize that ecological relationships are energy-oriented with radiant energy (sunlight) being the source and this energy is transformed from the radiant to the chemical form in photosynthesis and from the chemical to the mechanical and heat forms in cellular metabolism (in organisms);

1.3 justify why light is the most fundamental abiotic factor in an ecosystem;

1.3 predict the effects of the increase or decrease of the number of organisms in one level of the food pyramid;

1.3 explain what is being transferred between all organisms in a food chain, food web and food pyramid;

1.3 using the food pyramid justify why it is often larger birds that will die from DDT which washed into the sea;

1.3 using the food pyramid again relate the advantages and disadvantages of man eating plants versus eating high animals;

1.3 describe possible future marine food chains, food webs, and food pyramids;

2.1 point out ways that man does effect the food chains and webs;

4.3 evaluates the purpose and role of each organism in the ecosystem.

<u>Teaching Suggestions:</u> The purpose of this lesson is to present information to the student and help him understand the energy and nutrient flow within a marine ecosystem.

1. Have the students complete the readings and respond to the questions and activities.
2. Have the students meet in small groups to discuss the questions and/or cooperatively work on activities.
3. Reproduce the materials for the games on index card stock or on a lighter paper which can then be glued on posterboard or cardboard and laminated.
4. Have the students make an arrow for the spinner for the Dolphin game from index card stock or heavy material. Use a brass fastener to attach the arrow to the spinner board of the Dolphin game.
5. Grouping the students will reduce the number of copies and materials required and will lend itself to good interaction.
6. Encourage students to generate related questions and then strive to answer them cooperatively.

PRODUCER, CONSUMER...

LESSON SIX

ACTIVITY ONE

Read -

Producer, Consumer...

Separate -

The marine organism card deck into three groups: producers, consumers and decomposers.

Divide -

A sheet of paper into three columns. Label the columns: producer, consumer, decomposer. In each column list some organisms that belong in the column.

Separate -

The marine organism card deck into three groups: herbivores, carnivores, ominivores.

Look at -

Your sheet with the columns of producers, consumers, and decomposers.

Place -

The letter H by all herbivores,
The letter C by all carnivores,
And the letter O by all ominivores on your sheet.

Answer -

1. Is man a producer or consumer? Explain.
2. To which group, herbivores, carnivores or ominivores does man belong? Why?

PRODUCER, CONSUMER...

For life to exist and reproduce in an ecosystem, four components must be present. These four components are: (1) producers, (2) consumers, (3) decomposers, (4) non-living substances. Every living organism is either a producer, consumer, or decomposer, depending on how they get their food.

A producer is an organism that produces its own food from raw materials. The raw materials are the sun's energy, carbon, oxygen, and other chemicals. Green plants are the world's producers.

Organisms must feed on materials that already exist. They cannot make their own food. There are three kind of consumers, plant eaters (herbivores), flesh eaters (carnivores), and plant and flesh eaters (omnivores). Plant eaters are called primary (first) consumers. Flesh eaters are called secondary consumers. Secondary consumers are eaten by other consumers.

Organisms which feed on the dead are decomposers. They break down organisms into simple materials, the non-living materials. These are the materials that the plant uses to make its food. Bacteria and fungi are the best known decomposers. From non-living materials used by a producer to composer, to decomposer, the materials of life go in a full cycle.

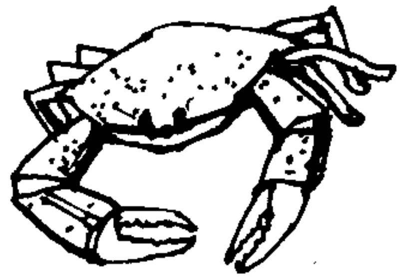
grass (cordgrass)

EATS:

plants make their own food

EATEN BY:

plant eating insects; crabs mice, rabbits



crabs filter feeders (porcelain)

EATS:

phytoplankton
zooplankton
detritus

EATEN BY:

shorebirds, swimming and diving birds, wading birds, crabs, turtle, flounder, fish-drums, trout, ray, otter

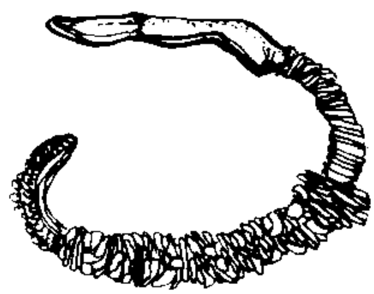
crabs (stone, calappa)

EATS:

oysters
barnacles
other crabs
clams
gastropods

EATEN BY:

crabs, ray fish-drums, red-fish, otter, croaker, trout, flounder, turtle wading birds, shorebirds, swimming and diving birds



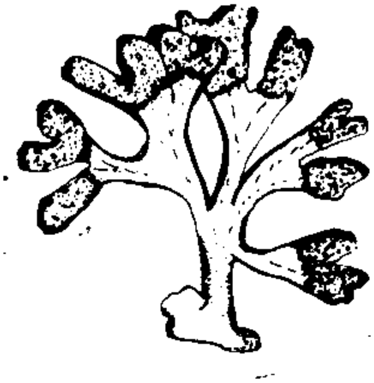
marine worms (tubebuilding worms, parchment, scale worms)

EATS:

detritus
zooplankton
algae
detritus
phytoplankton

EATEN BY:

shorebirds
mollusk-murex
turtle
shrimp



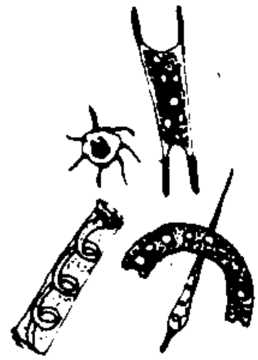
algae

EATS:

plants make their own food

EATEN BY:

marine worms, gastropods, fish, mollusks, water-fowl, filter feeders, deposit feeders



phytoplankton (diatoms)

EATS:

plants make their own food

EATEN BY:

permanent zoo plankton, temp orary zooplank-ton, barnacles, marine worms, mollusks, crabs

whale (pilot)

EATS:

fish-mullet, drum, croakers, trout squid

EATEN BY:

grass (widgeon grass) (turtle grass)

EATS:

plants make their own food

EATEN BY:

plant eating insects; crabs, mice, rabbits

wading birds
(heron, egret,
ibis, cranes,
spoonbill)

EATS:

shrimp
crabs
fish

EATEN BY:

alligator

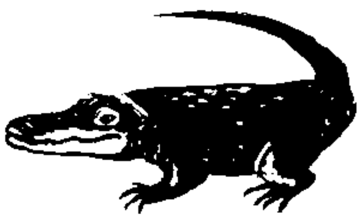
shorebirds
(gulls, terns,
sandpipers,
plovers, turn-
stones, surfbirds
plalaropes)

EATS:

marine worms
pelecypods
shrimp
crabs
insects
fish

EATEN BY:

hawks, alligator,
mink

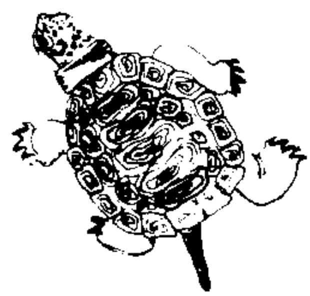


alligator

EATS:

fish
blue crabs
raccoon
muskrat
birds
turtle

EATEN BY:



turtle
(diamond back)

EATS:

grasses
mollusks
insects
crabs
worms

EATEN BY:

alligator

permanent zoo-plankton small crusta-ceans

EATS:

phytoplankton

EATEN BY:

temporary zoo-plankton, barn-acles, mollusks fish-mullet oyster, sea perch

plant-eating insects (grasshoppers)

EATS:

grasses

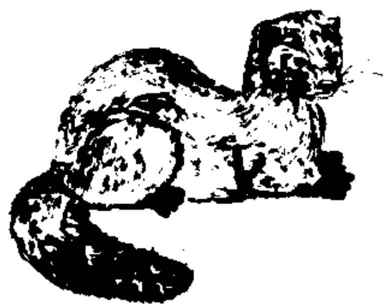
EATEN BY:

turtle, flying birds, seaside sparrow, shore-birds

death & decay

EATEN BY:

fiddler crabs, plant-eating insects, turtles mice, tiger bee-tles



mink

EATS:

fish
clams
mussels
mice
muskrats
birds

EATEN BY:

alligator
hawk

swamp rabbits

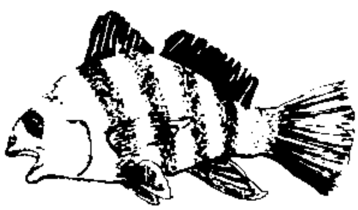
EATS:
grasses

EATEN BY:
alligator
hawk

river otter

EATS:
fish
crabs

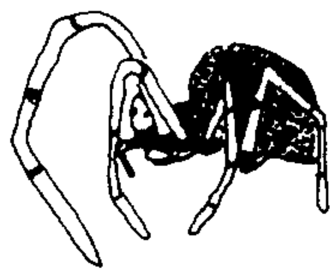
EATEN BY:
alligator



**fish—
(drums, redfish, croakers, trout)**

EATS:
shrimp
crabs
mullet
perch
mollusks

EATEN BY:
fish, dolphin, whale, otter



spiders

EATS:
plant-eating insects

EATEN BY:
flying birds, mice, seaside sparrow, shore-birds

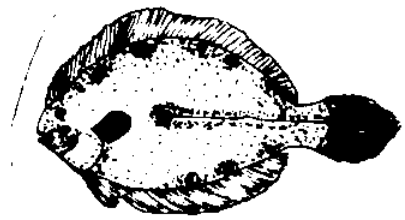
muskrat

EATS:

plants

EATEN BY:

hawk, mink,
alligator



fish—
flounder

EATS:

squid
shrimp
crabs
small fish

EATEN BY:

fish, shorebirds
dolphin, whale,
wading birds

fish—
redfish, snap-
pers, jackfish

EATS:

shrimp
squid
crabs
mullet
perch
small fish

EATEN BY:

fish, dolphin,
whale, otter,
wading birds,
shorebirds,
swimming and
diving birds

shark
(shovel-nosed
sand shark)

EATS:

crabs
shrimp
fish

EATEN BY:

other sharks

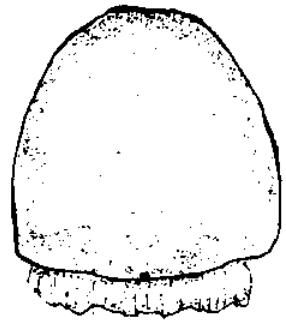
ctenophores (phosphorous jelly, sea walnut)

EATS:

temporary zooplankton

EATEN BY:

jellyfish
fish



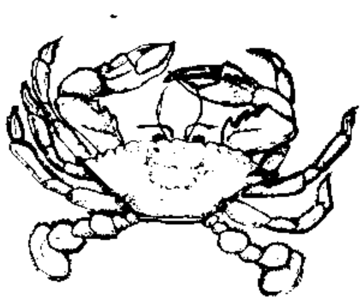
jellyfish

EATS:

filter feeders,
temporary zooplankton,
ctenophores

EATEN BY:

crabs



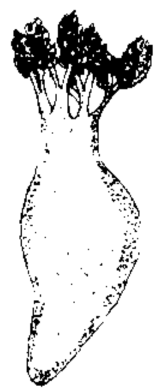
crabs—(blue, fiddler)

EATS:

detritus
grass
shrimp
fish
crab

EATEN BY:

turtles, seaside sparrow, fish-drum, red snapper
trout, redfish,
otter, ray,
sharks, flounder,
wading birds,
other crabs,
shorebirds



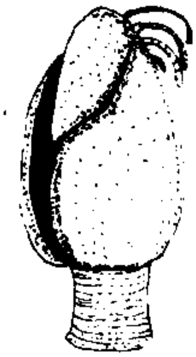
sea cucumbers

EATS:

detritus
plankton
algae

EATEN BY:

sea snails
melanella



barnacles

EATS:
permanent & temporary plankton, phytoplankton

EATEN BY:
mollusk drill, whelk, stone crab

squid

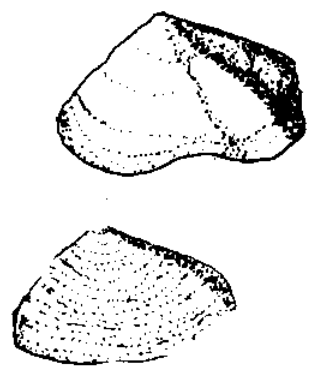
EATS:
small fish
shrimp

EATEN BY:
flounder
whale

permanent zoo-plankton (protozoans)

EATS:
phytoplankton

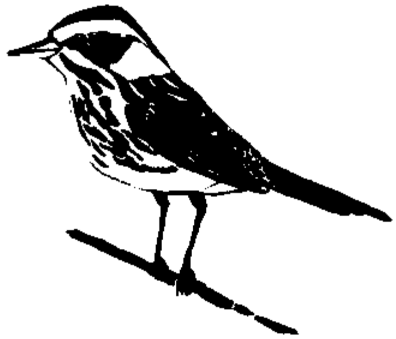
EATEN BY:
temporary zoo-plankton, barn-icles, mollusks, ish-mullet, sea oyster, phyto-plankton



mollusk—pelecypod deposit feeders (macomas, clams, tellins)

EATS:
detritus
algae

EATEN BY:
shorebirds, fish, swimming and diving birds,



bird
(seaside
sparrow)

EATS:
insects
crabs

EATEN BY:

waterfowl
(surface feeding
ducks, teal,
geese, swans)

EATS:
plants
detritus

EATEN BY:
hawks, mink,
alligator

swimming and
diving birds
(sea ducks,
stifftails,
grebe, comorants)

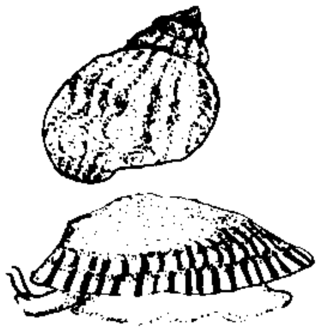
EATS:
shrimp
crabs
mollusks
fish

EATEN BY:
hawks, mink,
alligator

flying birds
hawks

EATS:
plant-eating
insects
birds
rabbits
mice
mink
muskrat

EATEN BY:



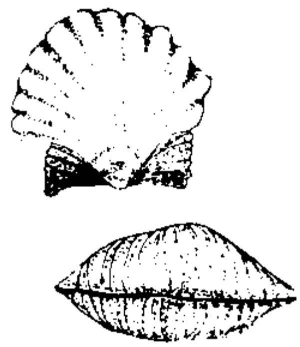
mollusks—gastropods (sea snails melanella)

EATS:

Portuguese-man-of-war,
jellyfish
sea cucumbers
sea anemones

EATEN BY:

fish, swimming and diving birds



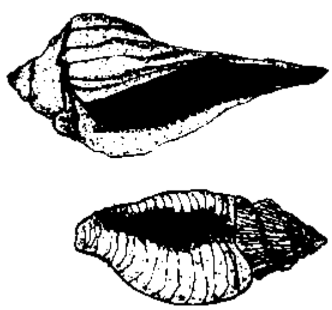
mollusk-gastropods, filter feeders (limpets, periwinkles, tegula slipper shell)

EATS:

algae
grass
phytoplankton
zooplankton

EATEN BY:

ray, turtle, saltwater perch, drum, redfish, trout



mollusks—gastropods (moon shell bonnet, drill, conch, whelk, murex)

EATS:

oysters
clams
mussels
other bivalves
worms
barnacles

EATEN BY:

ray fish, turtles
stone crabs,
shorebirds,
swimming and diving birds

mollusks—pelecypods filter feeders (bivalves, clams mussels, scallops cockles, donax)

EATS:

algae
plankton
detritus

EATEN BY:

moon shell, mink,
turtle, drill,
whelk, crabs,
drum-fish, shore-birds, s & d birds

mice

EATS:

grasses
plant-eating
insects,
spiders
detritus

EATEN BY:

hawks, minks,
muskrats

insects
(tiger beetles)

EATS:

detritus

EATEN BY:

birds
mice

shrimp

EATS:

algae
small clams
marine worms
temporary
zooplankton
small fish
other shrimp

EATEN BY:

squid, wading birds, shore-birds, diving and swimming birds, seaside sparrow, ray, saltwater perch, shark
fish-drum, red-fish, trout

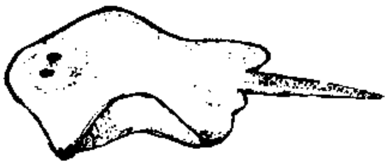
sea anemones

EATS:

small fish
zooplankton
(permanent
& temporary)

EATEN BY:

sea snails
melanella

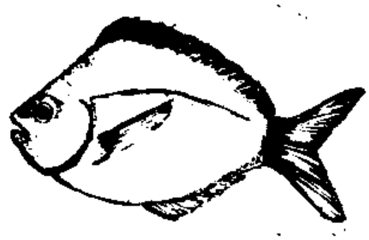


ray (stingaree)

EATS:

marine worms
mollusks
shrimp
crabs
plant material
detritus

EATEN BY:



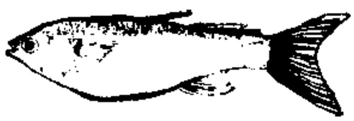
fish— saltwater perch or pinfish

EATS:

algae
plankton
small shrimp
crabs
mollusks

EATEN BY:

otter, redfish, dolphin, whale, redfish, snappers alligator, jack-fish, wading birds, swimming and diving birds, shorebirds



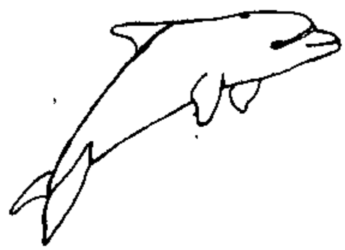
fish-mullet

EATS:

detritus
plankton

EATEN BY:

dolphin, otter, wading birds, shorebirds, swimming and diving birds, whale, fish-jack fish, drum, croakers, trout redfish, snapper

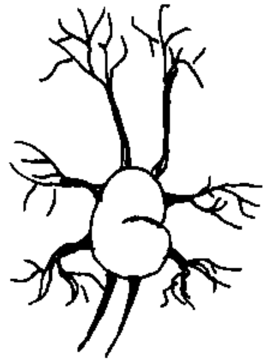


dolphin (bottle-nosed dolphin)

EATS:

fish-mullet
drum, croaker,
trout
flounder

EATEN BY:



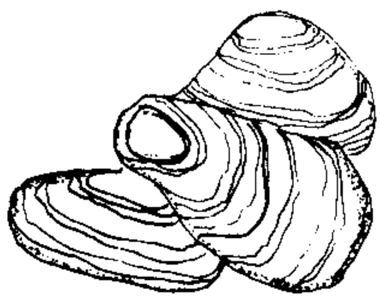
temporary zooplankton (larva of shrimp, oysters, mollusks, crab)

EATS:

phytoplankton
permanent zooplankton

EATEN BY:

ctenophores
jelly fish
filter feeders



mollusk—pelecypod (oyster)

EATS:

detritus
diatoms
phytoplankton
zooplankton

EATEN BY:

drill, conch, crabs-stone blue fish-drum shorebirds swimming and diving birds

detritus (disintegrated plant and animal material)

EATS:

EATEN BY:

crab-filter feeders, waterfowl, mice, mollusk, fiddler crab, blue crab, tiger beetle, marine worms

WHO'S FOR DINNER?

LESSON SIX

ACTIVITY TWO

Play -

Who's for Dinner? game using marine organism card deck.

Answer -

Questions.

WHO'S FOR DINNER?

1. Use the deck of marine organism cards.
2. As life in the salt marshes and bays goes on and on, so does this game. 15 to 30 minutes should be adequate.
3. Two to six players are best. More may play.
4. Deal all cards out. Some students may get more than others.
5. Person to the left of dealer starts play by asking any individual for a showdown.
6. At the same time, each of the two players lays down one of his cards. If one card "eats" another, that player takes the "eaten" card. If neither eats the other, it is a standoff, and each returns his card to his hand. Play goes on to the next person. If both cards "eat" each other, it is also a standoff.
7. When a player's turn comes and he knows where a certain card is that he can take with one of his cards, then he can challenge rather than ask for a showdown.
8. In a challenge, the player demands a certain card and shows the card with which he can take it. (Sally, I want your GRASS card, and I'm taking it with my PLANT EATING INSECT card.) He then wins the card and is entitled to another turn. As long as he can win cards in a challenge, he is entitled to another turn. (This is not so in showdown, even if someone wins.)
9. If the challenger was wrong and the person he challenged did not have that card, he must give up his challenging card to the person wrongly challenged and his turn is over.
10. When a challenger is no longer sure where the cards are that he can take, he should ask someone for a showdown, and this ends his turn.
11. Sometimes, two kinds of animals can eat each other. For instance, fish eat each other. In a showdown, neither takes the other. But in a challenge, the challenger does take the other card.
12. The two Death and Decay cards are very powerful. Their use is restricted: (a) Death and Decay may be used as a challenging card only once in a person's turn. (b) There are organisms that can take Death and Decay cards: anything that consumes decaying or decayed material. In a showdown, they provide a standoff with Death and Decay. In a challenge, the challenger wins. A person may capture

only one Death and Decay card by challenge in any one turn.

13. As players become familiar with cards and game, it may be necessary to restrict a player's time to one minute. That is, a player must challenge or ask for a showdown within one minute of his turn. Select a timer, someone who is not playing.

14. When the time set for the length of the game expires, the player with the most cards wins.

Answer:

1. When one organism eats another, what is actually passed from one organism to another?

2. What would all plants need to live?

WHO-EATS-WHOM CHAIN
(FOOD CHAIN)

LESSON SIX

ACTIVITY THREE

Read -

Who-Eats-Whom Chain.

Play -

Who-Eats-Whom using the marine organism card deck.

Answer -

Questions.

Build -

Four different food chains.

Share -

The chains you have built with your classmates.

Answer -

Questions on what would happen to the food chain under different circumstances.

Look at -

Sketches of the marine ecosystems in Lesson Five.

Draw -

As many food chains as you can see in the sketches.

Share -

The chains that you have found with your classmates.

<u>Optional</u>
Make -

Mobiles of the food chains in the different marine ecosystems. Use sketches of the organisms, string and coat hangers.

WHO--EATS--WHOM CHAIN

All food can be traced back to green plants. Without green plants nothing else can live. It is only the green plants that can capture energy from the sun and together with water, air, and soil change them into the chemical energy of foods. So the green plants produce the foods that keep the ecosystem running. No other form of life can do this.

All other living things depend directly or indirectly upon plants for food. You can picture this as a sequence of "who--eats--whom," or a chain within an ecosystem.In nature everybody seems to be food for some other creature. Plant eaters or herbivores eat plants. A herbivore is a first order consumer. They are then eaten by meat eaters (carnivores). A carnivore who eats a herbivore is a second order consumer. Carnivores are eaten by other carnivores. A carnivore who eats another carnivore is a third order consumer.Those carnivores are eaten by still other carnivores. In this way we get a food or energy chain that may have four or five links.

A four link chain may take place if grass is eaten by a fiddler crab a fish-flounder eats the crab and a wading bird eats the flounder. If the wading bird were eaten by an alligator then the chain would be made of five links.

All food chains end when the dead organisms or the waste products of living things, are eaten by fungi, bacteria and other agents of decay. These are the decomposers. They use the last energy left in the materials and break them back down to their basic elements. These basic elements, carbon and nitrogen, are returned to the air, soil and water. These elements are then used by the green plants to begin the cycle again. All food chains begin and end with water, soil and air. So all complete food chains begin and end with the basic elements that are used over and over again.

Plants are usually eaten by more than one kind of animal. A herbivore often eats more than one kind of plant. A carnivore usually eats more than one kind of animal. This more complicated patterm of "who--eats--whom" can be shown as a food web. A food web is a combination of two or more food chains that share some of the same plants and animals.

WHO EATS WHOM

1. Use the deck of marine organism cards.

2. Two or six may play.

3. Choose for dealer and score keeper. Mix the cards.

4. The dealer places the first card from the deck face down on the center of the table.

5. The cards are then dealt to the players until each player has seven cards in his hand.

6. The remaining deck is placed on the table.

7 The card in the center of the table is placed face up. This card serves as the basis for the food web the players will build.

8. The player to the left of the dealer is first to play. He may build up or down on the basic card. He builds on the basic card what it eats and what eats it.

   Example: Basic card
   $\boxed{\text{Oyster}}$

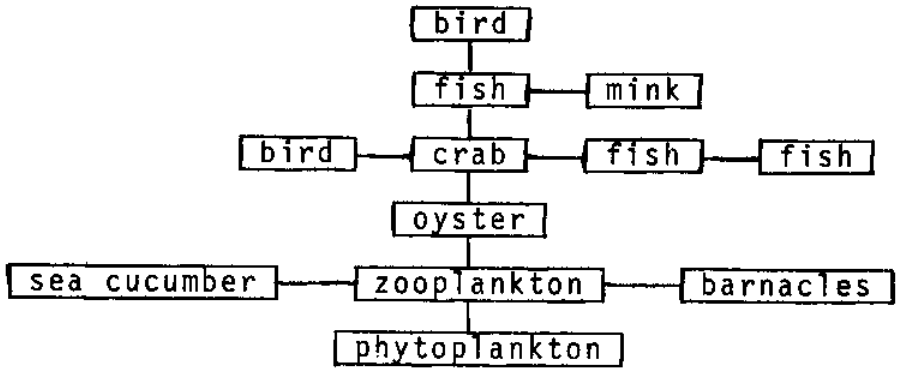
   The player can add $\boxed{\text{zooplankton}}$ to the bottom or $\boxed{\text{crab}}$ to the top in this case.

   $\boxed{\text{Oyster}}$
   |
   $\boxed{\text{zooplankton}}$

9. After he has played his card it is the turn of the player to his left.

10. Each player adds one card to the food web. If he cannot play when it is his turn, he draws from the deck until he draws one that he can play. If there are no cards left in the deck, he passes.

11. After several rounds the food web may be similiar to the example on the next page.



12. The first player to play out all the cards in his hand wins the game.

Answer

1. In each food chain, what is the first link?

2. Which animals are the first order consumers?

3. Where does man fit into the food chain?

4. Which animals are second order consumers?

5. Why can we say that not even green plants are independent organisms?

6. Why does a food web represent the food-energy relationships of an ecosystem better than a food chain?

Build The Following Food Chains

1. A food or energy chain with 3 links; a producer, a consumer and a decomposer.

2. A food chain with 5 links (using different organisms than in the first chain, if possilbe).

3. A food chain which has the same start and finish, but the rest is different.

4. A food chain on the ocean floor where no sunlight is present.

Answer

What would happen to the food chain if
(1) there were no nutrients (air, water, soil)?

(2) if the water became too muddy to allow sunlight through?

(3) if the decomposers were killed by chemicals?

(4) if man removed all fish by overfishing?

THE BIG WEB

LESSON SIX

ACTIVITY FOUR

Look at -

The sketches of the marine ecosystems in Lesson Five.

Draw -

The food web you find in one of the marine ecosystem sketches.

Compare -

The food webs of the different marine ecosystems.

Place -

Arrows or sting to show the food webs in your mural of the ocean.

Complete -

What Would Happen If ....? activity.

Read -

The Uninvited Guest.

Write -

A statement on "The effect of nutria on a coastal food web."

Optional
Read -

"Nutria Feast" Texas Parks & Wildlife Magazine , Vol. 33, No. 2 (Feb. 1975) pp. 20-22.

Describe or
draw -

A possible future food web.

Answer -

1. What substances or actions will effect the future food web?

2. Will future food webs be the same as they are today?

<u>Optional</u>
Play -

Food Web Tag. This is played in the school yard. Each student draws a marine organism card. He must try to get through the game without being eaten (tagged) and he must get enough to eat (tagging his food). Set a time limit. End of time limit would be the end of the day. Those marine organisms (Students) who have eaten and have not been eaten are the winners.

WHAT WOULD HAPPEN IF....?

Draw one card from the marine organism deck. Make a card with the organisms name on it. (Large enough so it can be seen.) Tape the name to yourself. Then using string, connect all organisms (represented by your classmates) that interact (eat) with each other. This will give you an idea of why the food-energy relationships in an ecosystem are more like a web than a chain.

Now illustrate the effect of some substances or actions on the food web you and your classmates are representing. You will do this by dropping all the strings you are holding if the organism you represent is killed or affected.

Illustrate the effect of some of the following actions or substances:

(1) A man sprays the edge of a bay or marsh with a herbicide (plant killing spray) to get rid of some unwanted plants.

(2) City X dumped so much sewage into the water that the decomposers used all the oxygen in the water.

(3) A pesticide killed all insects.

(4) There was an overpopulation of crabs.

(5) All the mollusks were killed.

(6) Add man to the food web.

Describe a possible future food web.

1) What substances or actions will effect it?

2) Will future food webs be the same as they are today? Why/why not?

THE UNINVITED GUEST

The nutria is a large rodent, nearly as large as a beaver, but with a long rat-like tail. Its natural range is South America. It prefers to live in swamps, marshes, and along the shores of rivers, lakes, and coastal estuaries, So the nutria are equally at home in salt and fresh water. Its natural food consists almost entirely of aquatic and semi-aquatic plants. When it lives along the coast, it also feeds on shellfish.

In Texas, it has been widely introduced as a "cure-all" for ponds, rivers and lakes choked with vegetation. It does eat many kinds of water plants, but it does not eat algae and many of the submerged plants. The problem is that once the nutria gets established in an area, its efficient reproduction soon leads to overpopulation. There are then so many nutria that there are not enough plants to eat. Then the trouble begins. The nutria moves into where it is not wanted. It also destroys plants that are valuable for waterfowl and muskrats.

In South America, the nutria were important as fur producers. In the United States, the muskrats are well established, and more valuable, fur producing animals. The nutria compete with the muskrats. We face the possibility of having our muskrats being driven out and replaced by the less desirable nutria. What is the effect of the introduction of an organism like nutria into a food web where it is not naturally a member?

NUTRIA

IT'S A PYRAMID!

LESSON SIX

ACTIVITY FIVE

Look at -

Sketch of a food pyramid.

Read -

It's a Pyramid!

Play -

Make a Dolphin.

Answer -

Questions on food pyramids.

Describe -

Possible future food pyramids.

Look at -

Sketches of Bay Food Pyramids.

Complete -

Managing a Small Bay Area.

IT'S A PYRAMID

Another way the giving and taking of food among plants and animals can be shown is in a food pyramid. In the food pyramid, each block represents a different organism. A food pyramid can be arranged to show:

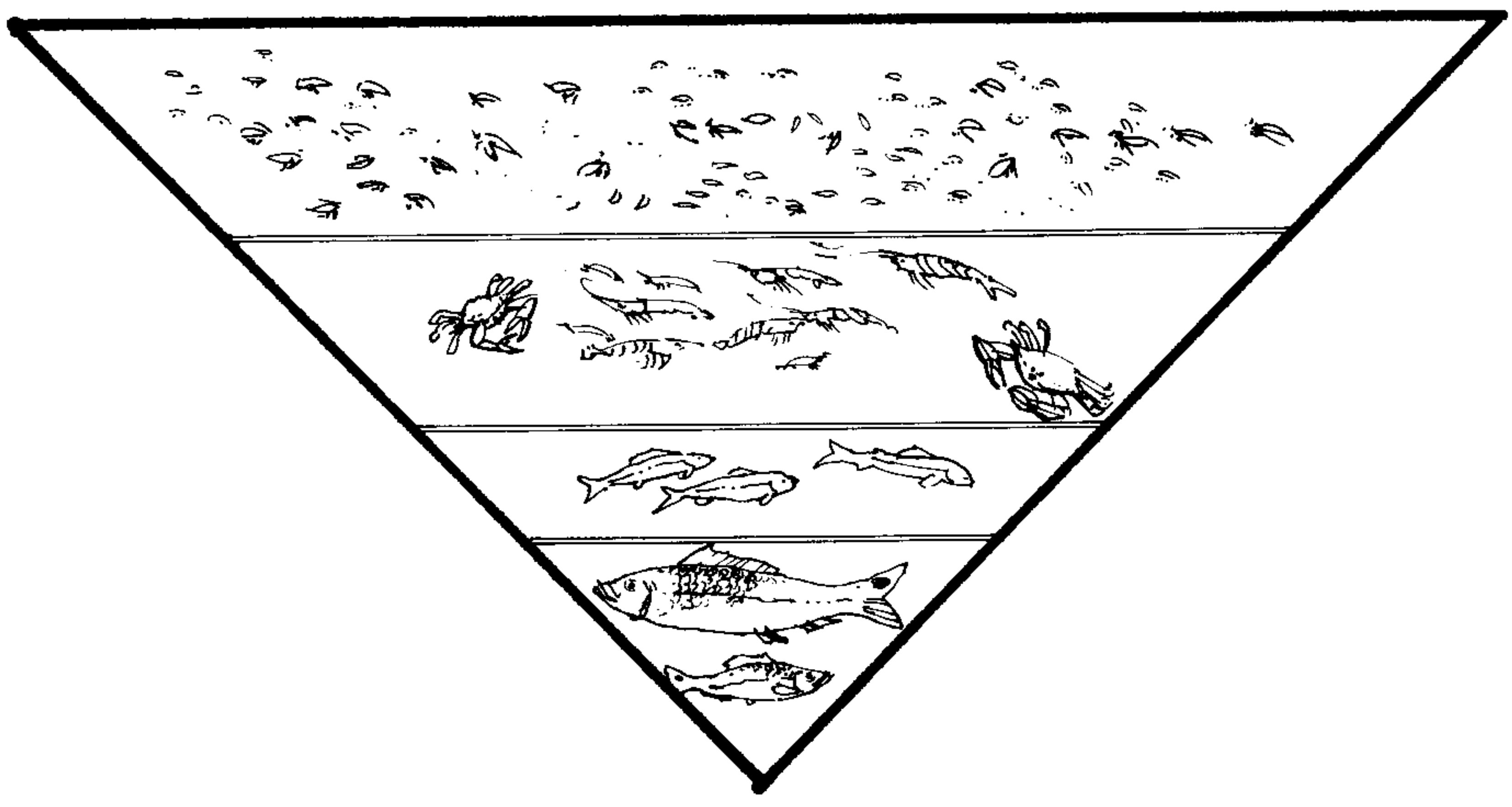
1) who eats whom

2) the amounts of food or energy one living thing needs compared to the amounts another living thing needs.

3) the differences in the numbers of organisms involved in each line of the chain.

4) not all the energy is passed from one level to the next. Some of the energy is used by the organisms in living so cannot be passed to the next level. Some energy is lost in being passed on. With each level there are fewer and fewer members. A food pyramid cannot show the true feeding patterns of organisms, since many may eat a wide variety of organisms.

THE FOOD PYRAMID



MAKE A DOLPHIN

The purpose of this game is to create a dolphin using the following food chain: diatoms, copepods, oyster, crab, fish-flounder, dolphin.

Each feeding level (trophic level) of the chain represents a different amount of food material. Since only 10 percent of the material at each level is used to build the organism at the next higher level; it will take 4,000,000 lbs. of diatoms; 400,000 lbs. of copepods; 40,000 lbs. of oyster, 4,000 lbs. of crab; 400 lbs. of fish to make one 40 lb. adult dolphin.

Rules

1. Two or more play.

2. One player is chosen to keep score and to hand out the food chain cards.

3. Lots are drawn to decide the starting player. The next player is the one to his left.

4. Each player is given a diatom card at the beginning of the game.

5. Players move through each link of the food chain by collecting the amount of weight written on the cards.

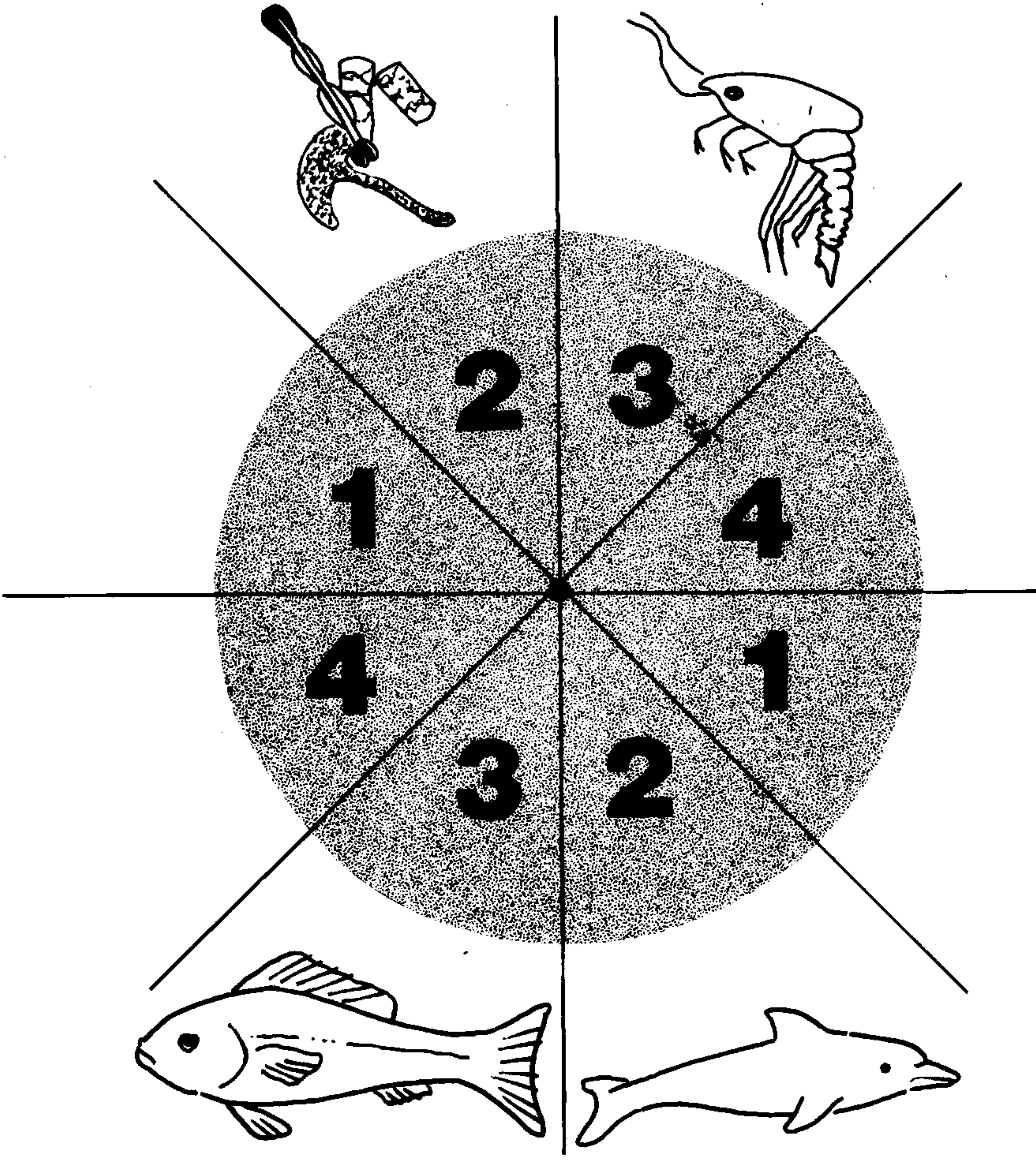
6. Each card states the value of the units on the spinner board. (e.g., #3 on board=3 unit times the value of a unit on the food chain card.)

7. As each player reaches the amount written on his food chain card, he trades the card with the score keeper for the next card in the food chain.

8. The first player to move through the entire food chain to the dolphin becomes the winner.

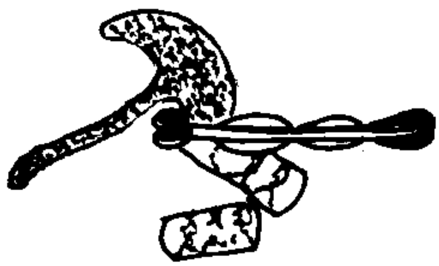
9. Each player is allowed one spin at a time. The arrow must go around one full turn from its starting point. If it does not, or stops on a line, the player must spin again.

DOLPHIN



DIATOMS

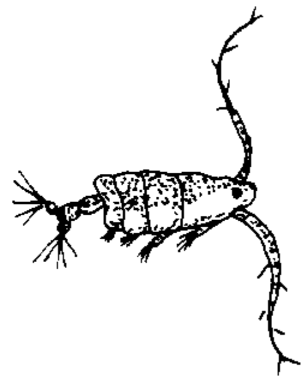
This card represents tiny sea plants (phytoplankton). It takes 4 million pounds to make a dolphin.



Each unit on the wheel is worth 100,000 lbs.

COPEPODS

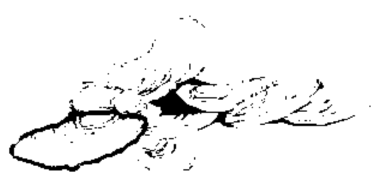
This card represents tiny sea animals (zooplankton). It will take four hundred thousand pounds to make a dolphin.



Each unit on the wheel is worth 10,000 lbs.

OYSTER

This card represents the oyster. It will take forty thousand pounds of oysters to make a dolphin.



Each unit on the wheel is worth 1,000 lbs.

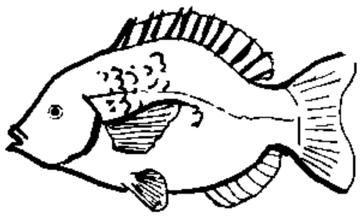
CRABS

This card represents crabs. It will take four thousand pounds of crabs to make a dolphin.

Each unit on the wheel is worth 100 lbs.

FISH

This card represents free-swimming fish. It will take four hundred pounds of fish to make a dolphin.



Each unit on the wheel is worth 100 lbs.

DOLPHIN

This card represents one forty pound dolphin.

FOOD PYRAMID QUESTIONS

Answer:

1. Which organisms in the pyramid have the largest numbers? Are they consumers or producers?

2. Organisms at which level require the most energy? the least energy?

3. Which organism would give off the most energy as it is decomposed?

4. If you wanted to feed fish efficiently would you feed them a 1st order or 2nd order consumer? Explain.

5. Using the food pyramid, can you offer a possible explanation of why it is that larger marine birds, like the Brown Pelican, have died from DDT which was sprayed on plants to kill insects?

6. With more and more people being born all the time, what must happen to the bottom of the food pyramid?

7. Which is more efficient for man to eat, grass or beef?

8. At the present when man eats fish, the food chain is algae, zooplankton, fish, fish, man. What would be the effect of man feeding algae and plankton to cattle and then eating the beef?

9. More and more plant materials are being used all the time to take the place of meat. Would you eat a "hamburger" made from algae or plankton?

10. With our population continually increasing should we consider using sea weeds and algae (algae flour, seaweed salads, soup and cookies and etc.) as food for man? Explain.

MANAGING A SMALL BAY AREA

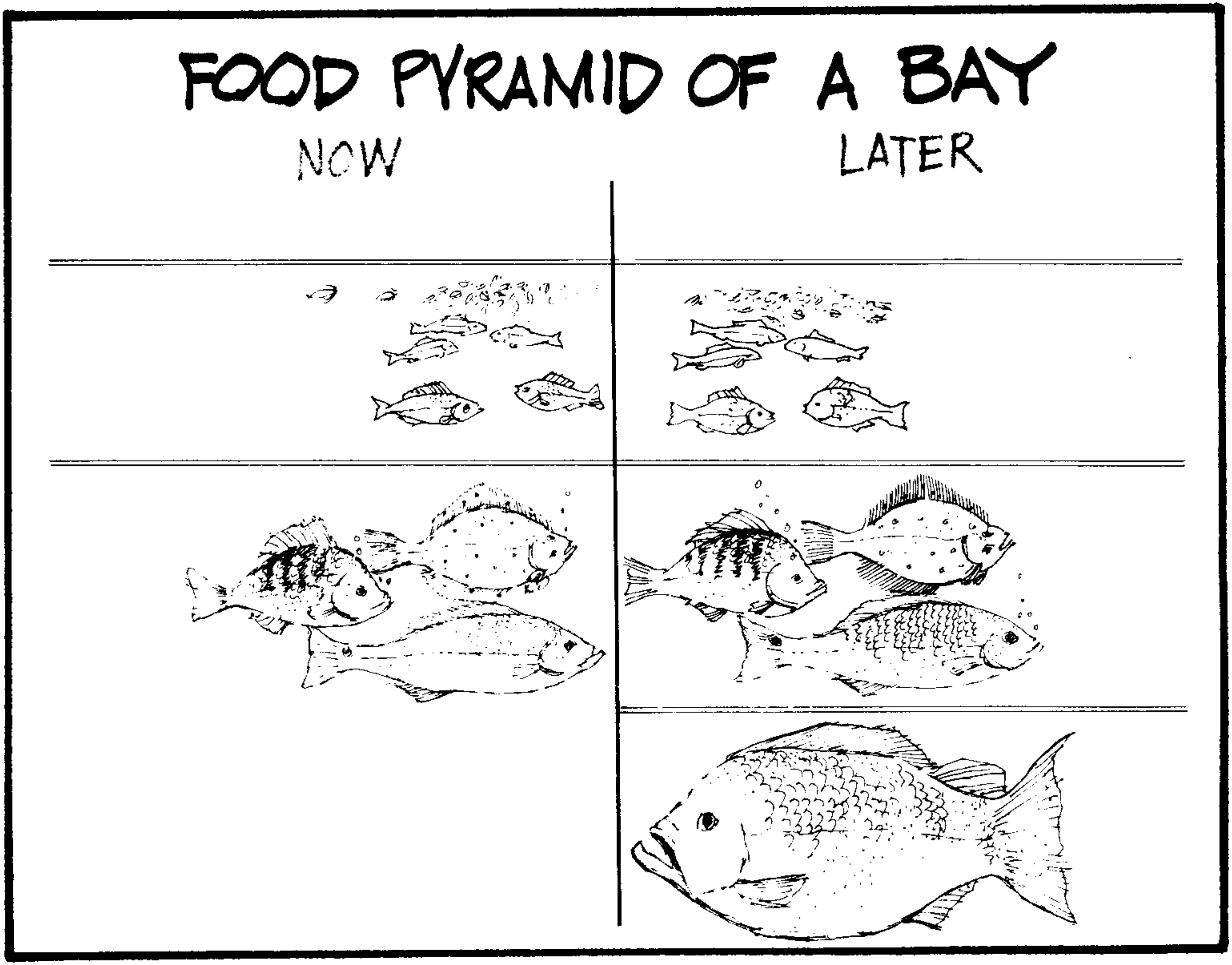
Mr. and Mrs. T. Brown just bought land around a small bay. The bay does not contain any large fish that are exciting to catch. But there are some medium size fish such as croaker, mullet and perch. The diagram shows the food web in the bay area now.

Around the bayshore there are weekend and vacation homes, boats to rent, and a store that sells bait and food to the vacationers.

The Browns want to attract more fishermen to the bay. They have decided to add a new species of fish to the bay. These new fish grow to a large size and are exciting to catch. After the new fish are added to the bay, the food web will be like the diagram---

The Browns assume that the bay will support as many medium-sized fish as before, plus a good number of the new large fish. They think more fishermen will want to fish in the bay and the families who already came to fish for the medium size fish will still be satisfied and will continue to fish in the bay.

What do you think will happen with the new fish in the bay? Use the space below to write a statement to the Browns. Tell them whether their plan will work. Give reasons to support your position.


FOOD PYRAMID OF A BAY
NOW
LATER

LESSON SEVEN
THE BIG CIRCLE

ACTIVITY ONE-The Circle of Water
ACTIVITY TWO-The See-Oh-Two and On-Two Cycle
ACTIVITY THREE-The Nitrogen Cycle
ACTIVITY FOUR-The Not So Perfect Cycle

Suggested Time for Classroom Use of Materials: Approximately 4 class periods

Materials for Classroom Use:

Water Cycle/reading
Memo from Wally Rainstorm/reading
Water cycle/drawing
The See-Oh-Two and Oh-Two Cycle/reading
Man and the See-Oh-Two and Oh-Two Cycle/reading
Carbon-Oxygen Cycle/drawing
Nitrogen Cycle/reading
A Nitrogen Crisis?/reading
Nitrogen Cycle/drawing
The Not So Perfect Cycle
Phosphorous Cycle/drawing

Major Objectives for the Lesson: After completing the lesson the student will be able to:

1.4 diagram and explain each of the following cycles in marine ecosystems: water, oxygen, carbon, nitrogen, and minerals;

1.4 conclude that all living things originally came from non-living material and also that the elements of which living things are made are basically the same as those of non-living materials and these elements move in cycles and are recycled;

1.4 identify the vehicles which carry out the processes of energy flow and nutrient recycling in a given marine ecosystem;

1.4 make inferences as to what would happen if each of the cycles if there were:
(a) no plants present
(b) no animals present
(c) no microorganisms present
(d) no sunlight

2.1 describe ways in which man has, could, or will affect each cycle in the past, present, and projected future;

2.3 appraise the effect of a given interruption (past, present and projected future) on each cycle.

Teaching Suggestions: The purpose of this lesson is to present information to the student on material cycles and help him understand their role in an ecosystem.

1. The readings could be handed out the day before and read as a homework assignment.
2. The students will read and complete the activities and discuss as a whole class.
3. Encourage the students to generate additional questions and to try to answer them cooperatively.

THE CIRCLE OF WATER

LESSON SEVEN

ACTIVITY ONE

Read -

Memo from Wally Rainstorm.
The Water Cycle.

Look at -

The diagram of the Water Cycle.

Divide -

A sheet of paper into three columns.
Label them as follows:
Part of Cycle
Water Coming From
Water Going To

Fill in the columns.

Answer -

The questions on the Water Cycle.

MEMO TO: Captain Al G. Seaborne

FROM: Wally Rainstorm

SUBJECT: Water Resources

From the pine forests of East Texas to the farmland of the west, from the Red River south to the Gulf Coast, there is a common Texas problem - water.

Sometimes there is too much water, more often too little. It's brackish here, salty there. It flows wildly in some regions, not at all in other areas. It is a very valuable but limited resource. People, industry and agriculture must have water.

Texas is an example of the problem in the United States. We have rainfall from 6 inches in the west to 90 inches in the East. We have the desert and the lush plains and forests.

A doomsday projection could paint an ugly picture of the future of Texas.

- Houston sinking into Galveston Bay
- Dallas-Fort Worth losing its growth potential
- The fertile High Plains and Lubbock turing into a dessert
- The Rio Grande Valley's recreation, retirement and economic growth stopping
- Hundreds of small towns facing enormous expenses to provide water
- El Paso depleting its ground water
- Cities fighting over water rights
- Salt deposits polluting major waterways

and on and on.

We are not doomed,but we do have critical problems. The state has a relatively adequate water supply at present. However, increasing population and dropping ground water supplies pose a critical situation in the years ahead.

Three-fourths of the earth's surface is covered by water -

mostly salt water. We cannot drink it and most plants cannot grow in it. Can we take the salt out of the sea water and get fresh water? Can we do it cheaply enough to make it practical for drinking, farming, and other use? Scientists have found the answer to the first question and are trying many methods to answer the second question.

Sincerely,

Wally

Wally

WATER CYCLE

So you don't live near the ocean. And you think that it doesn't matter to you. Wrong!

Water is the substance which makes the earth unique. It is the most abundant single substance on the earth. Almost three-fourths of our body weight is water, so we are water creatures on a unique water planet. Some forms of life can live without air, but none can live without water. With all the water available on the earth, less than 1% of the worlds' water is special to us--this is the usable kind of water we drink and use everyday in countless ways.

Look at the global circle in which water moves. Water is evaporated from the oceans and from land and is taken into the atmosphere. There it travels as invisible water vapor or visible clouds until it falls back to earth as rain, hail, sleet or snow. It is absorbed back into the earth and reappears in rivers, streams, and lakes and eventually back to the sea.

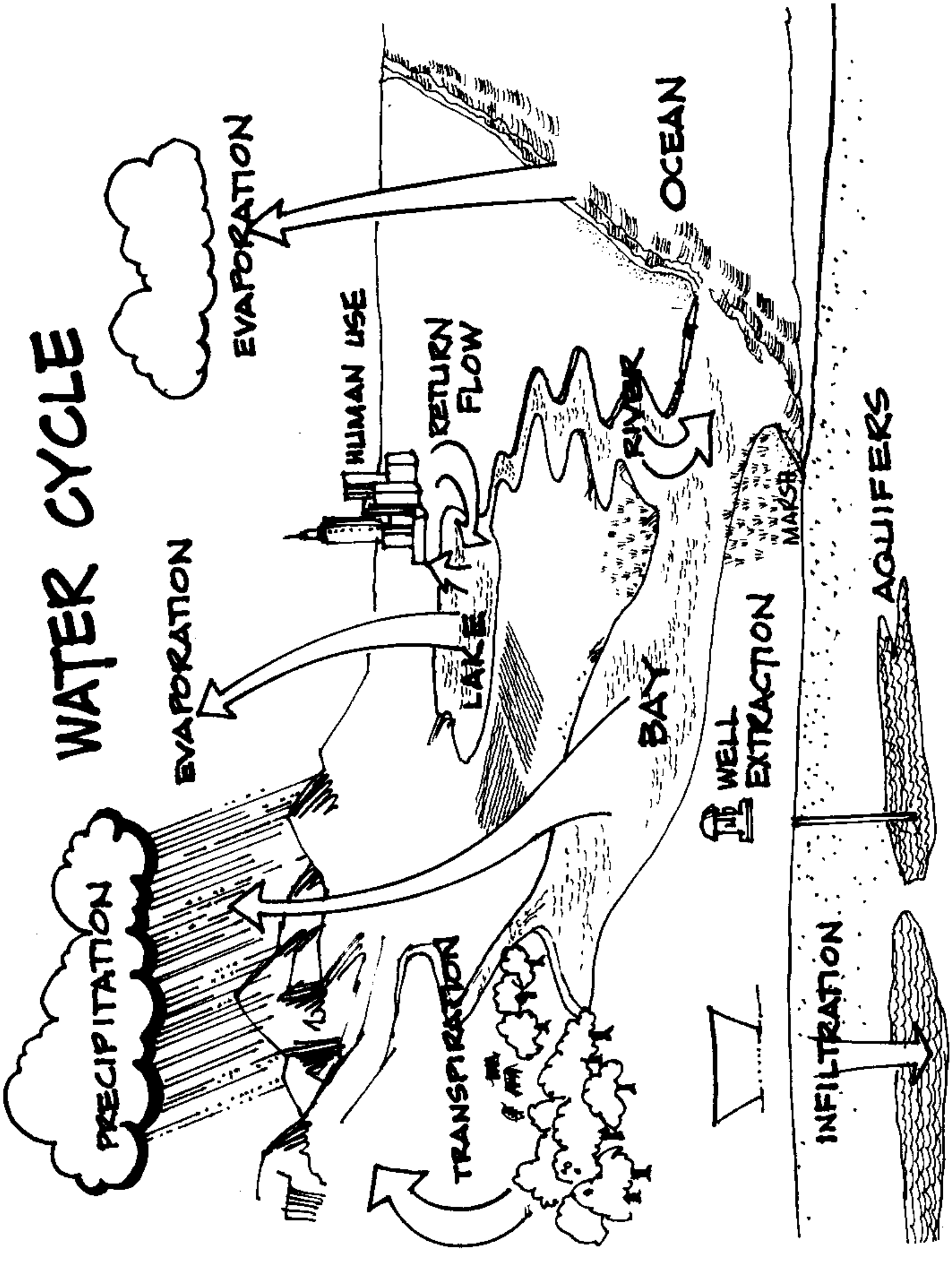
Much of the soil water is taken up by plants. Plants on land and in the water itself use the oxygen and hydrogen from water to make sugars and starches. The water also has dissolved in it nutrients needed by plants and animals. Excess water is evaporated from the land plants through small pores in the leaves--this is transpiration. Water is also added to the air by the respiration of animals and by the decomposition of decaying materials. The largest part evaporates from the oceans, with the remainder coming from land and landwaters.

The water that goes out from the surface of the earth returns in equal amounts, creating a cycle. While this cycle is balanced for the whole planet, the rates of precipitation and evaporation for individual areas vary. The amount of water on the earth does not increase or decrease,it is unchanging. It is all part of a cycle in which water is not "lost", but changes form or locality.

The irony of the water cycle is most obvious along the southern Texas coast where one is surrounded by water, but where usable water is scarce. the salt water of the Gulf is still a resource, but to meet man's and the wetlands' needs for fresh water, ocean water must be recycled through the processes of evaporation, rainfall, and runoff.

The water cycle also points out that there are not many oceans or seven seas. There is only one, that surround our planet and runs through our countries, our bodies and our lives.

Therefore, as citizens of a water planet, we must realize that any mis-use of water, wherever it occurs, has effects that extend around the globe and into each of our lives. Useable fresh water is the limiting natural factor in not only the Texas Coastal region but all over the world.


WATER CYCLE
PRECIPITATION
EVAPORATION
EVAPORATION
HUMAN USE
RETURN FLOW
LAKE
RIVER
OCEAN
BAY
MARSH
WELL EXTRACTION
TRANSPIRATION
INFILTRATION
AQUIFERS

WATER CYCLE QUESTIONS

1. What is the source of energy that moves water in the cycle?

2. Explain the statement "The water you drank today may have been used by Adam and Eve to cook their food."

3. What is the role of living organisms in the water cycle?

4. What forms does water take in the cycle?

5. How is the water cycle related to our weather and climate?

6. Why is the water cycle important to marine organisms?

7. How does and can man effect the cycle?

ONE BIG CIRCLE

LESSON SEVEN

ACTIVITY TWO

Read -

The See-Oh-Two and Oh-Two Cycle.

Look at -

Diagram of the Carbon-oxygen cycles.

Read -

Man and the See-Oh-Two and Oh-Two Cycle.

Divide -

A sheet of paper into five columns.
Label them as follows:
Carbon Coming From
Carbon Going To
Oxygen Coming From
Oxygen Going To

Complete the information in the columns.

Answer -

The questions on the carbon-oxygen cycles.

THE SEE-OH-TWO AND OH-TWO CYCLE
(CARBON--OXYGEN CYCLE)

Carbon and oxygen are life's major building blocks. About every fourth atom in the body of an organism is an oxygen atom. Starches, sugars, fats, proteins, ATP, DNA, RNA are all molecules which are made of a skeleton of carbon atoms. We cannot live without them. The amount of carbon and oxygen on earth does not change, only its location and form in the cycle.

Oxygen in the atmosphere is found as O_2--two oxygen atoms bonded together.

Photosynthesis is the process by which oxygen is produced and released to the atmosphere. This is done by plants using energy from the sun and water to make carbohydrates. Plants of the oceans produce over 85% of the earth's oxygen. Oxygen is taken from the atmosphere by plants and animals during the process of respiration; the decomposition of decaying materials; and the burning of fuels--coal, oil, wood. Carbon travels in its cycle as carbon dioxide (CO_2) combined with two oxygen atoms.

During photosynthesis, carbon dioxide is removed from the atmosphere. Plants use it along with energy from the sun and water to make carbon compounds. Carbon dioxide is released to the atmosphere through the respiration of plants and animals, decomposition the burning of oil, coal, and wood, and volcanic eruptions.

If it were not for the decomposers, all carbon would be locked up in organic matter that could not decay. If there were no plants, there would be no oxygen. If there were no oxygen, there would be very little life on earth. Therefore, living organisms depend on one another in order to stay alive.

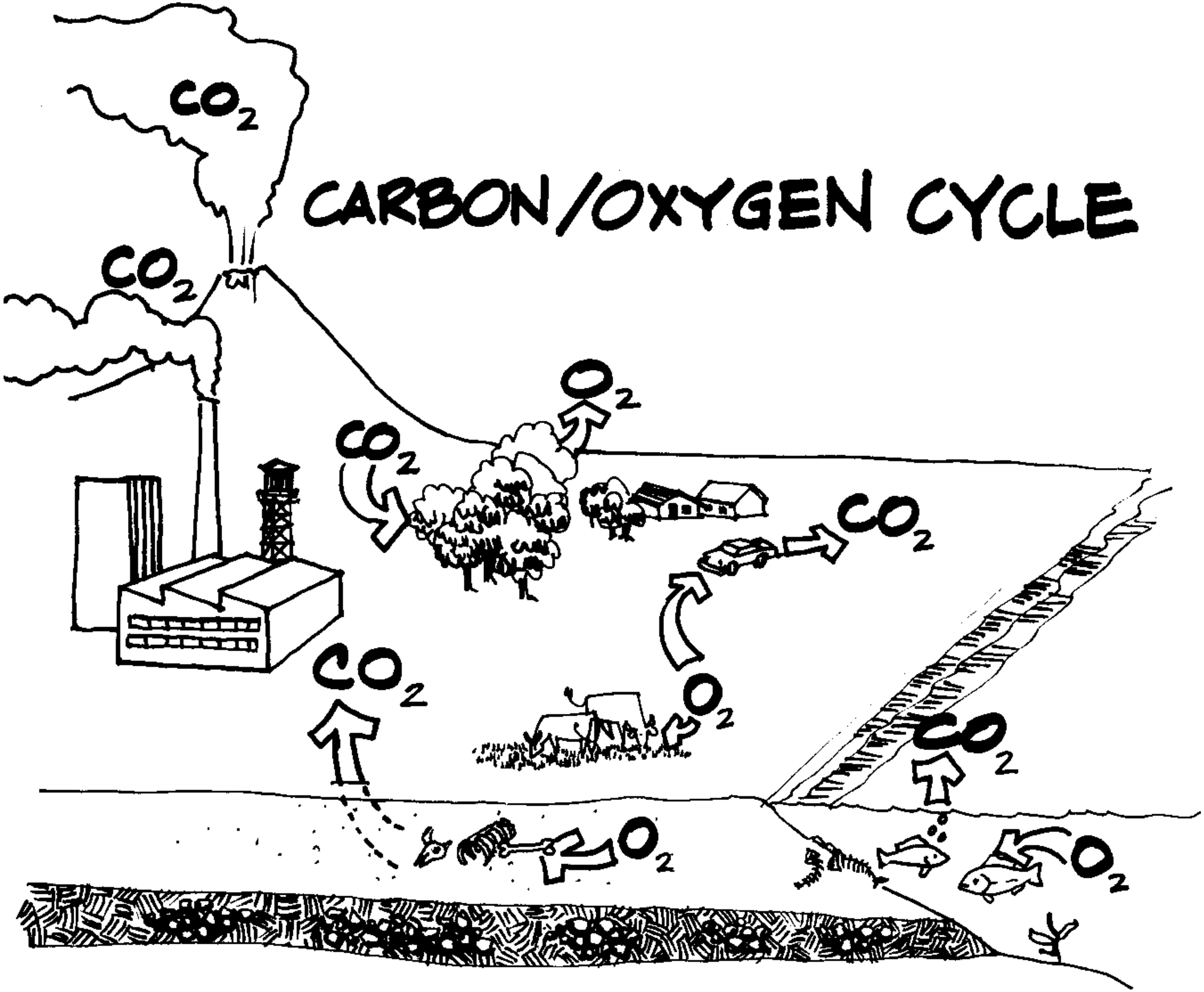
MAN AND THE SEE-OH-TWO AND OH-TWO CYCLE

Man has had tremendous impact on the carbon-oxygen cycle. However, we have no precise evaluation of man's effect. Let us look at some potential problems.

Suppose the supply of oxygen to the atmosphere were cut off. A cause of this would probably be something that would stop photosynthesis by the phytoplankton in the sea or plants on land. To carry on photosynthesis phytoplankton need light. What kind of effect would a thin layer of oil or other contaminants, such as pesticides and mercury, have on organisms that are necessary to the environment? Scientists worry about such questions because they don't know the answers.

Large amounts of sewage and pollutants are being added to bays, salt marshes, estuaries and the ocean itself. This would lead to an increase in the decomposers. They would use more oxygen to break down the wastes. This would leave less oxygen and maybe none for the crabs, shrimp and fish. Without oxygen they would die. Again scientists don't have an answer.

Another big question is related to the amount of carbon dioxide in the atmosphere. Carbon dioxide in the atmosphere causes what is called "the green house effect." In other words, carbon dioxide acts like the roof of a greenhouse by holding heat close to the earth. What will happen if man dumps too much carbon dioxide into the atmosphere by burning fossil fuel (coal & oil)? One, plant growth is speeded up. Also the average temperature of the earth may increase. This could cause the polar ice to melt, raising the level of the oceans and flooding many coastal cities. It would also mean a decline in agricultural production. However, man may run out of fossil fuels before this could happen. Again science has not found the answer.


CARBON/OXYGEN CYCLE
CO2
CO2
CO2
O2
CO2
CO2
O2
CO2
O2
O2

QUESTIONS ON CARBON-OXYGEN CYCLE

1. What is the role of animals in the cycle?

2. What is the role of plants in the cycle?

3. What organisms use oxygen and for what purpose?

4. Why is all the oxygen in the form of O_2 considered to have originated from a living organism?

5. What role do bacteria play in the cycle?

6. What effect will the following activities of man have on the cycle?
   A) Removing plants
   B) Using more fossil fuels-coal, oil, gas
   C) Using herbicides to kill unwanted plants in bays and waterways

THE NITROGEN CYCLE

LESSON SEVEN

ACTIVITY THREE

Read -

Nitrogen Cycle
A Nitrogen Crisis?

Look at -

Diagram of the Nitrogen Cycle.

Divide -

A sheet of paper into three columns.
Label them as follows:
Part of Cycle
Nitrogen Coming From
Nitrogen Going To

Fill in the columns.

Answer -

The questions on the nitrogen cycle.

NITROGEN CYCLE

Nitrogen is needed by all living things. It is an important part of proteins, DNA, RNA, and ATP. Four-fifths of the earth's atmosphere is nitrogen gas. However, only very few plants and animals can use it in this form.

The nitrogen is "fixed" so that it can be used by other organisms, by plants such as legumes. Most of the nitrogen fixers are microorganisms - bacteria and algae. Once fixed, it can be used by other organisms.

There are several pathways fixed nitrogen can take. One is from the nitrogen-fixing plant to the animal that eats it. When the animal decays, the nitrogen compounds are released and can be reused by the plants. In this cycle, nitrogen does not get back to the atmosphere. A variation of this cycle is that some of the nitrogen released from animal or plant bodies by decomposure goes into the soil. Instead of being reused by a plant, it is washed out of soil and enters the water. Here is may enter any number of different marine food webs.

A third pathway actually releases nitrogen back to the atmosphere. This is done by denitrifying bacteria in the soil. The cycle is complete. Nitrogen goes through many chemical changes in its cycle, and all of them depend, in some way on bacteria. However, we still do not know how it occurs in marine habitats.

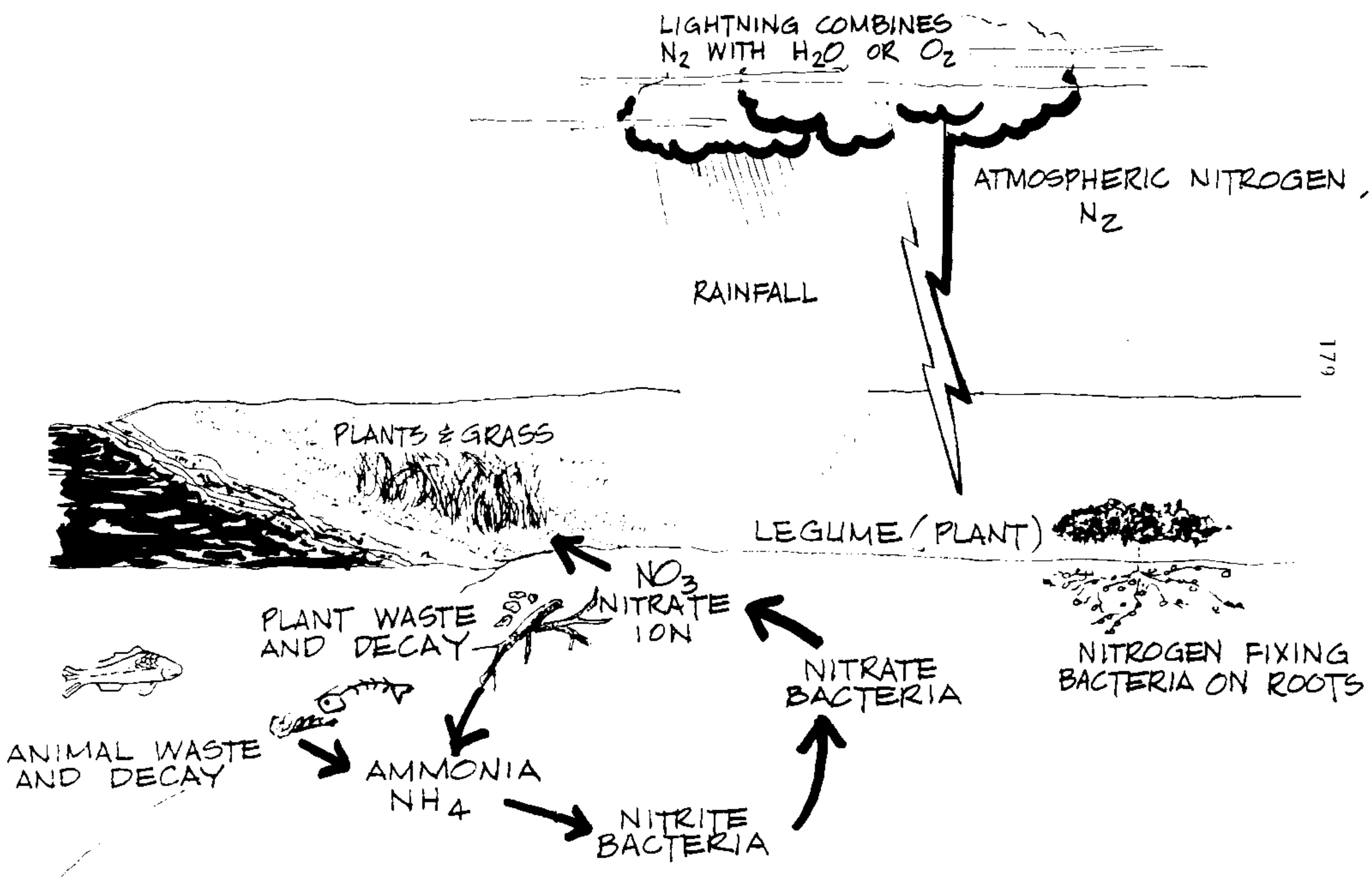
A NITROGEN CRISIS?

Are we going to have a nitrogen crisis? One of the most significant things that man has done to disrupt the natural cycles on earth is the large scale dumping of fixed nitrogen. This fixed nitrogen is in the form of fertilizer. It amounts to about 30 million metric tons per year. This is done to increase agricultural crop yields, which is a necessity if all humans on earth are going to have food. Right now, the phase which returns nitrogen to the atmosphere is far behind the input phase of the cycle. The imbalance will get worse in the future as demands on crop production increase. How long can the nitrogen cycle stay out of balance? What will happen after millions and millions of tons of fixed nitrogen are added to the soil? Right now nobody know what is likely to happen.

We do know what happens if the nitrates (nitrogen compounds) are greatly increased in lakes, bays and estuaries. It causes a rapid increase in certain algae. Often the growth is so great that the algae either cover the water or color it. This is an algal bloom.

The algal bloom greatly increases the quantity of living material in a body of water. The large amount of algae will eventually die. The increased dead matter triggers an explosion of the bacterial decomposers. The decomposers release nutrients from the dead algae to the water. These nutrients cause another algae growth. This causes more dead algae and more bacterial decomposers. The overall result is a cycle. However, the cycle does not continue forever. The decomposers use oxygen that is dissolved in the water. This is the same oxygen that all the other animals in the lake use. Eventually, the decomposers use so much of the oxygen that two things happen: (1) the fish and other animals that need large amounts of oxygen die, and (2) the decomposers die and therefore drop in numbers. The dead matter, plants, animals and decomposers, collect on the bottom and age the lake. The overall process of aging is called "eutrophication." Could we do this to the Gulf of Mexico or the oceans with our dumping of sewage and fetilizers? We have done it to Lake Erie.

THE NITROGEN CYCLE



NITROGEN CYCLE QUESTIONS

1. What organisms are needed to change nitrogen to different chemical forms?

2. Why does man need nitrogen?

3. How does man get nitrogen?

4. What would happen to the cycle if all decomposers were destroyed by chemical pollution?

5. How do you think man will effect this cycle in the future?

THE NOT SO PERFECT CYCLE

LESSON SEVEN

ACTIVITY FOUR

Read -

The Not So Perfect Cycle.

Look at -

Diagram of the Phosphorous Cycle.

Divide -

A sheet of paper into three columns.
Label them as follows:
Part of Cycle
Phosphorous Coming From
Phosphorous Going To

Fill in the columns.

Answer -

The questions on the phosphorous cycle.

THE NOT-SO-PERFECT CYCLE

Oxygen, carbon and nitrogen are only three of the elements needed by organisms. There are many more that are needed in smaller quantities and must be recycled. Of these elements, phosphorous is a typical example we can use to show a different type of cycle.

Phosphorous,like many other essential elements,is not normally found in the atmosphere. In the carbon, oxygen and nitrogen cycles the atmosphere served as a "storage bank" from which they could be withdrawn and deposited. The cycle of phosphorous does not include this "storage bank".

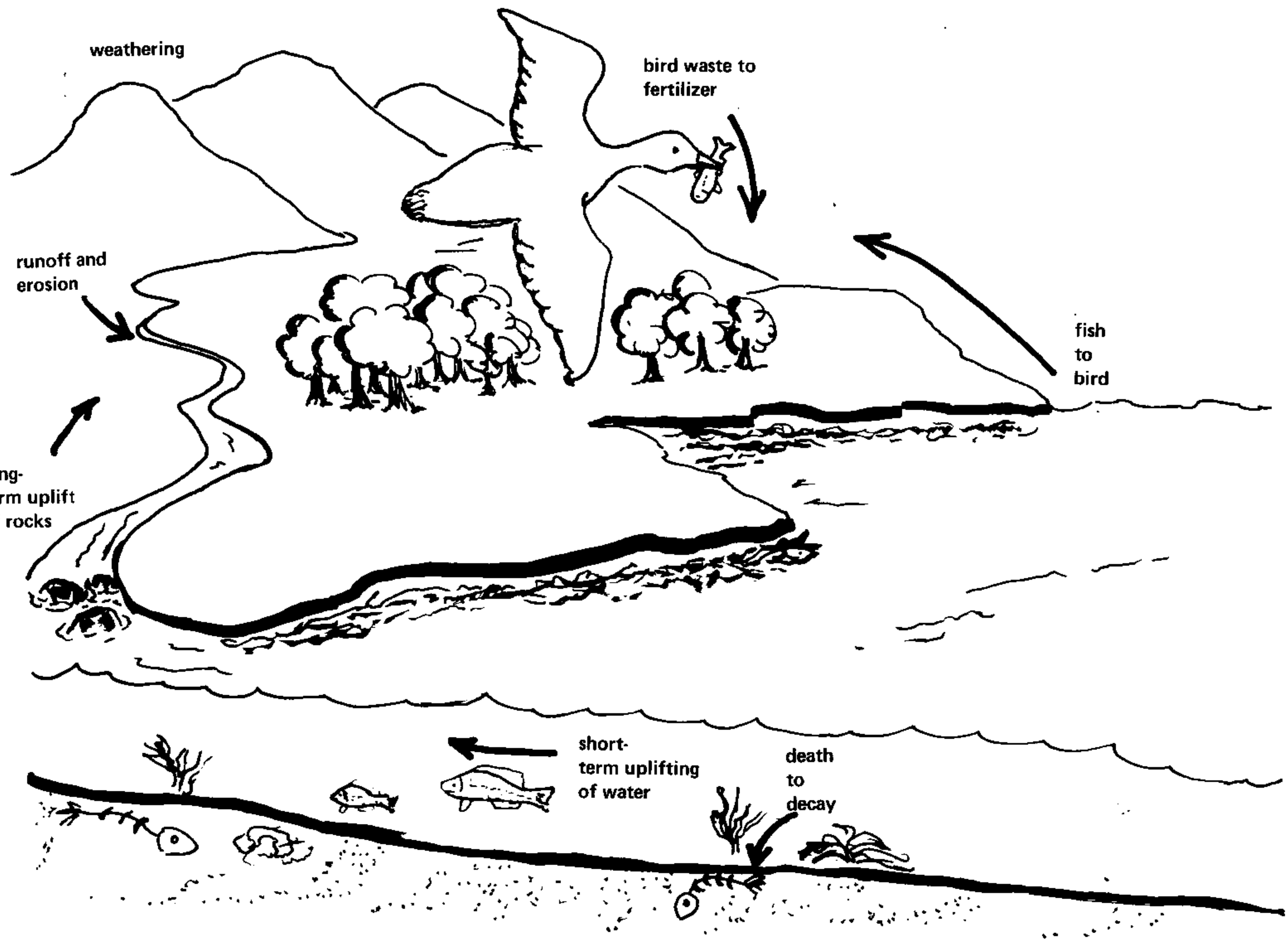
Phosphorous is mainly present in the form of phosphate rocks. Throughout the years, these rocks are broken down by forces of weathering and erosion. Some of the phosphorous will remain in the soil and be used by plants. In the land ecosystems, the phosphorous will be cycled from the bodies of plants to animals, and then back to plants by the decomposers.

Some of the phosphorous will be washed into the aquatic and marine ecosystems and will be carried into the oceans. The cycle is not perfect in marine waters. There is actually a loss of phosphorous from the cycle in marine ecosystems. Some of the phosphorous settles to the bottom of the ocean and forms phosphate rocks. Therefore it is normally a one-way cycle ending in the sea.

There is an interesting exception to this one-way path. This may be of some importance in returning phosphorous to the land. On certain islands there are tons of phosphates that have been deposited over the years from the wastes of sea birds. This material, called "quano," also contains nitrogen. For many years it was one of man's chief sources of fertilizer. Therefore, some of the phosphate lost in the sea is returned (about 5%) to the land by sea birds, thus completing the phosphorous cycle.

As with the other cycles, man is affecting the phosphorous cycle. Like nitrogen, phosphorous is also causing problems in water because of eutrophication. This is a result of the increased use of phophate fertilizer and phosphates in detergents. What will happen? Will there be more cases of eutrophication?

PHOSPHORUS CYCLE



PHOSPHOROUS CYCLE QUESTIONS

1. Why is phosphorous needed?

2. Why is the phosphorous cycle called a non-perfect cycle?

3. How could man's addition of fertilizers and detergents containing phosphates effect this cycle?

4. Some ecologists fear that we will use up all of our phosphates, nitrogen and other fertilizers because they will be washed out of the soil and deposited in the oceans. Explain why they are saying this.

LESSON EIGHT
SUM IT UP

ACTIVITY ONE-Man and the Marine Environment
ACTIVITY TWO-Evaluate and Plan for the Future

Suggested time for Classroom Use of Materials: Approximately 3 to 5 class periods

Materials for Classroom Use:
What Do You Say?/activity
Spaceship Earth/reading
I am only One/reading and response
Mercury in Lavaca Bay/reading
Man and the Marine Environment/drawing
"Super-Preservative" for Sale??/activity
It's Your Decision/activity
A Mariculture System for the Future/activity
P.S./activity
Newspapers
Magazines
Glue
Scissors
Coloring and writting materials

Major Objectives for the Lesson: After completing the lesson the student will be able to:

1.4 construct a future cycle of a marine ecosystem;

2.1 interpret man's relationship to the environment in the statement that man is a part of nature rather than above or outside of nature;

2.1 give examples of ways man's activity can be beneficial to the energy flow and the nutrient cycle;

2.1 comprehend that man can and does affect the process of energy flow and nutrient cycling;

2.1 illustrate ways man can be damaging to the energy flow and nutrient cycle (oil spills, pesticides, dredging and etc.);

2.1 analyze newspaper and magazine articles for evidence of man's effect on energy flow and the cycles;

3.1 evaluate a particular individual act in relation to the environment;

3.1 discuss the idea that men are responsible for their activities;

3.4 devise a plan for improving the productivity of wide ocean areas by controlling or improving the process of energy flow and nutrient cycling. (mariculture);

4.3 evaluate his position concerning the marine environment;

4.3 advocate a position in relation to the marine environment.

Teaching Suggestions: The purpose of this lesson is to have students identify ways in which man is affecting the process of energy flow and nutrient cycling to propose responsible management of the marine environment.

1. Have the students complete the readings and respond to the activities and sketch. (This may be done by distributing the materials on the previous day.)

2. In small groups and/or as a whole class discuss the acitvities.

3. The collecting of newspapers and magazine pictures and articles that show evidence of man's effect on energy flow or nutrient cycling can be a homework assignment.

4. Individually or in small groups make the collage.

5. In small groups, plan the mariculture system and as a whole class discuss each group's plans.

6. Encourage the students to generate related information and questions and then strive to research and answer them.

7. Additional references for use are:

National Geographic Magazine

The Imperiled Everglades, Vol. 141, No. 1 (Jan. 1972) pp. 1-27
Fragile Nurseries of the Sea-Can We save Our Salt Marshes? Vol. 141, No. 6 (June 1972) pp. 729-765

Texas Parks & Wildlife Magazine

Die-off, Vol. 32, No. 3 (March 1974) pp. 2-5
Young Naturalist:Predator-Prey Relationship, Vol. 32, No. 12 (Dec. 1974) pp. 28-31
Transplanted Plants, Vol. 34, No. 3 (March 1976) pp. 2-5
Gambusia (Mosquito Control is this Fish's Role in the Ecological System), Vol. 34, No. 12 (Dec. 1976) pp. 16-17
Young Naturalist:Water, Vol. 35, No. 4 (April 1977) pp. 28-31

MAN AND THE MARINE ENVIRONMENT

LESSON EIGHT

ACTIVITY ONE

Complete -

What Do You Say? activity.

Read -

Spaceship Earth.
I Am Only One.
Mercury in Lavaca Bay.

Look at -

Man and the Marine Environment.

Write -

Your answer to "Super-preservative" for Sale?

Share -

Your answers and your reasons with your classmates.

Make -

You choice and defend it in "It's Your Decision".

Collect -

Newspaper and magazine pictures and articles that show evidence of man's effect on food webs or the material cycles.

Make -

A collage using the materials collected to illustrate man's intervention in the ecosphere.

WHAT DO YOU SAY?

All this talk about the destruction of our coastal environment is stupid. There isn't any problem.

YOU

Our salt marshes are being destroyed! In 20 years there will be none left.

YOU

Do you ever pollute?

We need the resources from the sea to survive!!

YOU

YOU

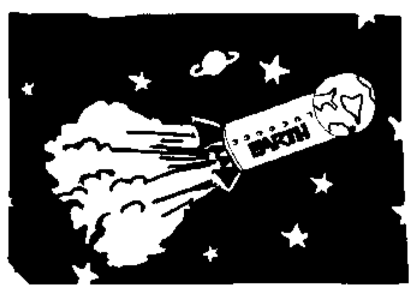
SPACESHIP EARTH

The earth is a giant ecosystem which Lamont Cole called "ecosphere." As an ecosphere, the earth may be compared to a giant spaceship; this means that the earth receives only energy from the outside. It recieves no materials from the outside; all it has are already on the earth.

Like a spaceship, the earth's capacity to receive wastes is limited. Life on a spaceship does not survive without fresh water, neither can life on earth. Life on a spaceship cannot obtain food from the outside; neither can life on earth. Life on a spaceship can probably discard its wastes; life on earth cannot yet do this. Therefore, life on earth must learn to live with its wastes.

The earth is like a spaceship which can get no new materials or get rid of its wastes. So it must recycle the materials and make sure the cycles keep operating.

The cycles are kept in operation by organisms. These organisms struggle to stay alive, to get food, to grow and to reproduce. The cycles depend on the organisms and the organisms depend on the cycles. They can not survive without each other. Every organism is important and has a role in keeping spaceship earth alive. If enough individuals are destroyed, spaceship earth will be changed.



I AM ONLY ONE

I am only one. I am not affecting the oceans. The chemical plants are doing the polluting.

Pollution problems are usually blamed on industries and the needs of large cities. We don't think that the industries are in business because some of us want their products. Most people don't think they personally pollute their own environment, at least not seriously.

Think about the materials that you probably add to the water or soil. For example, when you wash a car, fertilize the lawn, take a bath, or even brush your teeth, you add new substances to the environment.

The soaps, toothpastes, and chemicals, along with human wastes, go into a drain or a sewer. Some cities may have sewage plants to partially treat the wastes. But whether the wastes are treated or not, most of the substances you add to the water cannot be removed. The sewer finally empties into a river and it into the ocean. Some chemicals get into water in another way. Fertilizers and weed killers often sink down through the soil into underground water sources. This water eventually drains into streams and lakes and finally the ocean. Do you think these chemicals affect our waters and the living things in them? Do you think about how these substances affect food webs and material cycles? Do you think about pollution when you run soapy bath water down the drain? Should you?

Your responce is:

MERCURY IN LAVACA BAY

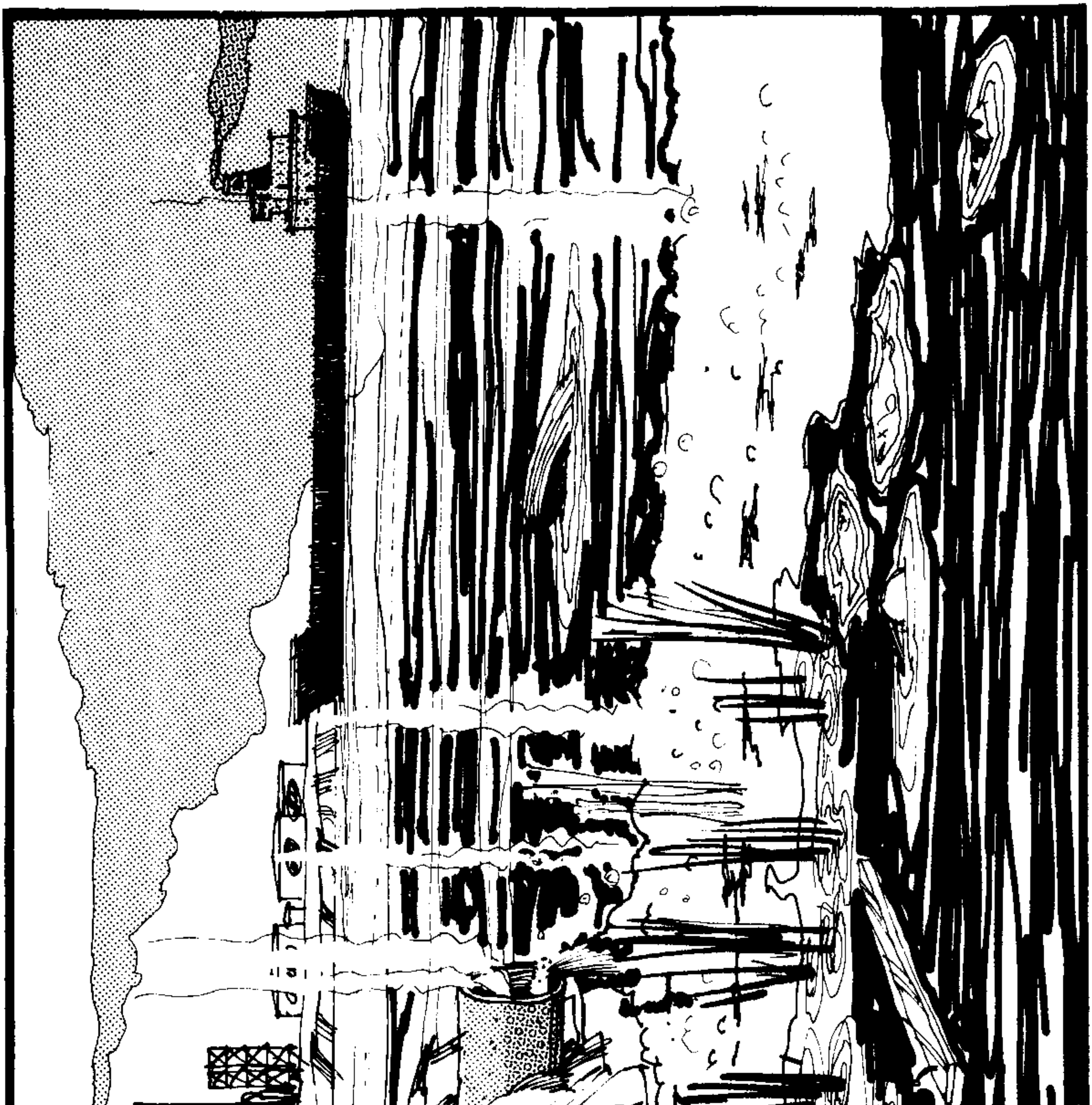
Picture a bay with plenty of fish, crabs, and shellfish. It has also boat ramps, piers and a state park. Sounds perfect for the weekend fisherman.

Wrong! Below the surface the picture is different. It is the only fishing area in the state where the fish and crabs have unsafe levels of mercury. This became a problem in 1970 when the U.S. Food and Drug Administration found that the oysters and crabs from Lavaca Bay had high mercury levels. These levels were higher than one-half parts per million, which is considered safe for man to eat.

The culprit was an industrial plant near Point Comfort. The plant immediately changed its procedures. In four months, the oysters returned to normal, but the crabs continued to have high levels of mercury. The theory is that the mercury in the bay sediments is eaten by small organisms. These small organisms are then eaten by crabs and fish. The mercury builds up in the fish's tissue and continues as long as the fish eat contaminated organisms.

So even in 1978, the state has had to re-issue warnings against harvesting crabs and finfish. They could be harmful if eaten regulary. Recent samples have had mercury levels from just over the safe level to as high as 5 parts per million in some cases.

In 1970, the Blue Crab harvests were 200,000 lbs. The commercial crab industry has not harvested in the area since the warning, a great economic loss to the area. A concern is that the weekend fisherman may not be aware of the problem, especially if he is from out of town.



"SUPER-PRESERVATIVE" FOR SALE??

You are a scientist who discovered a new chemical. Any living thing sprayed with this chemical would not decay when it died. Even animals that ate treated organisms would not decay when they died. The chemical stops decomposers from growing. It is harmless in all other ways.

The leaders of several large countries want to know if they should add this chemical to their foods. It could increase their food supply by 20% since that much it normally lost to decay. Also, billions of dollars are lost as a result of food which could be spent helping the needy. They are even thinking of spraying all farmlands in their country. They offer you several billion dollars for the chemical. What advice would you give the leaders? Would you sell them the chemical?

Write your advice below.

IT'S YOUR DECISION

You are a city health officer. You have been receiving complaints about the large number of mosquitoes on the beach. People are afraid that they may be disease-carrying again. Several years ago there was an outbreak of encephalitis carried by the mosquitoes.

You know the mosquitoes are hatching in some of the pools in the salt marsh.

Your options as you see it are:

(1) to spray with DDT

(2) to spray with another insecticide

(3) fill in the pools where they are hatching

(4) put oil on the water where they hatch so the larva will have no oxygen and die

(5) add dragonflies to eat the mosquitoes

Write your choice and defend it in the space below:

EVALUATE AND PLAN FOR THE FUTURE

LESSON EIGHT

ACTIVITY TWO

Plan -

A mariculture system for the future.

Complete -

The P.S. activity.

A MARICULTURE SYSTEM OF THE FUTURE

The earth is facing a food shortage for many reasons. The main reason is the increase in the population. Also,the growth of the   is removing farmland from use. There is an increase in the demand for sea food. However, most of our own fishery resources already are being harvested to the greatest extent possible.

We are beginning to turn to farming of the sea or mariculture--growing of marine plants and animals. In some countries it is already established.

Plan-- A mariculture system of the future.

Remember-- the design which works the best will be like a natural ecosystem and will not upset the balance or the cycles. Also,the design which works the best will be used by others,with more recognition and rewards for you.

Things to consider in your design.

<u>Location</u>-- on land, bays, open ocean or etc.

<u>Which organisms to grow & number</u>--one, several or many

<u>Light, tides, currents, location of nutrients</u>

<u>Food, chains, webs, food pyramids</u>

<u>The material cycles</u>

<u>How to harvest and restock organisms</u>

Draw--your plans. Give explanations for your selection.

P.S.

As you look back over what you have learned about the marine environment and the material cycles, what do you think about?

Maybe the following incomplete sentences will help you organize your thoughts.

I learned that I ______________________________

______________________________.

I learned that the marine environment ______________________________

______________________________.

I urge ______________________________ to ______________________________.

Who ______________________________?

What can be done to ______________________________

______________________________?

I would like to ______________________________

______________________________.

I will ______________________________.

I ______________________________

etc. ______________________________

______________________________.

LESSON NINE
CHANGES

ACTIVITY ONE-Change is Natural
ACTIVITY TWO-Changes in Man's Activities in the Coastal Zone

Suggested Time for Classroom Use of Materials: Approximately 2 to 3 class periods

Materials for Classroom Use:
Introduction to Change/activity
Changes in a Larger Environment/activity
It's Natural to Change/reading
Spectacular Agent of Change/reading
Once There Was One, Now There Are Two!
Sequential Changes in Matagorda Delta/drawings
10,000 B.C./reading
4,000 B.C. to 1,000 A.D./reading
1520 A.D. to 1800 A.D./reading
1800 to 1900/reading
Future/reading
Changes in Man's Activities on the Coast/drawings

Major Objectives for the Lesson: After completing the lesson, the student will be able to:

1.1 define change;

1.1 cite examples of changes that occur;

2.2 evaluate changes in the environment;

2.2 examine marine environment of the past and present and analyze changes;

2.2 conclude that the environment of any locality will change with the passage of time;

2.2 compare and contrast marine environments of the past and present;

2.3 point out environmental problems that have existed in the past and that exist today;

3.1 analyze changes in marine environment to determine factors causing them;

3.1 examine marine environments of today and formulate possible future changes;

3.1 hypothesize about the consequences of man's manipulation of the environment in the past, present and projected future.

Teaching Suggestions: The purpose of this lesson is to have the students identify ways in which the marine environment naturally changes and changes in man's activities in the coastal zone in relation to the marine environment.

1. The students will complete the readings and use the sketches to identify and analyze natural and man-made changes in the marine environment. (The materials may be distributed on the previous day.)

2. In small groups and/or as a whole class, discuss the readings and activities.

References from Texas Parks and Wildlife Magazine

Our Changing Coastline, Vol. 34, No. 6 (June 1976) pp. 2-5

The Storm God, Vol. 34, No. 7 (July 1976) pp. 24-27

Hurricanes on the Texas Coast, Texas A & M University-Sea Grant, no. TAMU-SG-75-504, 1975

Hurricane, The Greatest Storm on Earth, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Washington, D.C. 1971

CHANGE IS NATURAL

LESSON NINE

ACTIVITY ONE

Complete -

Introduction to Change activity.

Read -

It's Natural to Change.
Spectacular Agent of Change.
Once There Was One, Now There Are Two!

Look at -

Drawings of Sequential Changes in Matagorda Delta.

List -

Natural changes that occur in the coastal zone.

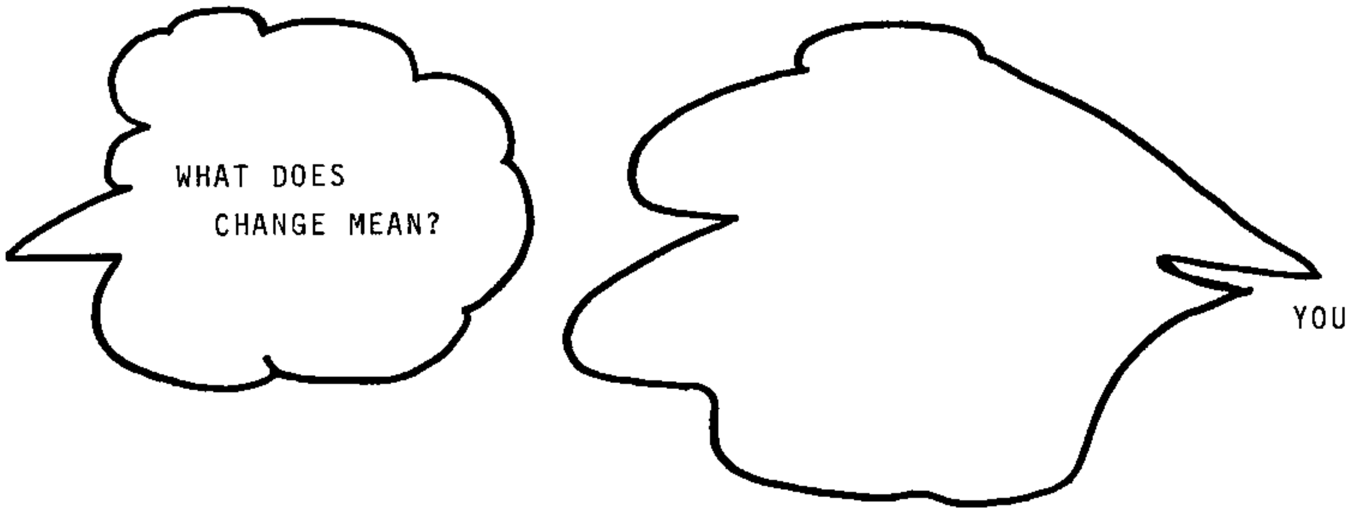
Sketch -

In your projection of the future Matagorda area in no. 7.

Answer -

The questions.

INTRODUCTION TO CHANGE



WHAT THINGS CHANGE?

WHAT THINGS DO NOT CHANGE?

WHAT CHANGES OCCUR IN OUR SCHOOL ENVIRONMENT ?

WHAT CHANGES IN OUR HOME ENVIRONMENT?

WHAT CHANGES OCCUR IN YOUR MOODS?

Lets look at changes in a larger environment--our society and the earth.

OVER CROWDING?

WATER POLLUTION?

FLOODS

DISEASE

AIR POLLUTION?

HURRICANES

HOW DO THESE MAJOR CHANGES AFFECT PEOPLE AND SOCIETY AS A WHOLE?

HOW DO THESE CHANGES AFFECT THE BEHAVIOR OF PLANTS, ANIMALS & MAN?

YOU

YOU

IT'S NATURAL TO CHANGE

Natural processes are constantly changing and shaping the coastal region. These processes include: stream runoff; sediments being deposited; wave erosion of the shoreline; storm surge; flooding; ground sinking; faulting and sand dune movement. The processes are the result of natural interactions of climate, soil and water systems.

These processes are the agents of change. They make sure that the coastal region continually changes. These changes occur not only in shorelines but also in bays, marshlands and river courses. These changes are vital to the survival of the ecosystems. Floods flush the bays, and although this may seem to have bad effects on the organisms, it is followed by an increase in productivity. Marsh changes ensure the continuous cycling of nutrients needed for the marine organisms.

However, some of the changes conflict with our use of the land. The conflicts usually occur where we have gotten in the way of natural processes or unknowingly upset balances.

We need to know about these changes so we will not upset balances.

To learn more about these changes, the Matagorda Bay area was selected as a model for developing ways of watching and recording shoreline changes. This area was selected because this part of the coast has been the least affected by man's activities. Therefore, the changes that occur are due to natural processes.

From this study, we have already learned that 60 percent of the Texas Gulf shoreline is erosional. The erosion of the shoreline in the Matagorda area has been approximately 1,300 feet over the last 100 year period. That is an average rate of 13 feet of shoreline that is lost each year. The principle cause is natural. Certain of our activities have helped to speed up the erosion. Therefore, it is important that we understand the changes so that our development of the area can be sound and balanced with the effects of natural changes.

SPECTACULAR AGENT OF CHANGE

A few hours before there had been a thriving seaport--with its costly homes and beautiful churches. Warehouses filled with varied products of commerce and splendid shops on business streets now lay in ruins. Pavements and gardens were a mess. Every house was carried away or left in ruins. The cause a hurricane, the greatest storm on earth. The death of Indianola--the mother of western Texas--was due to the visitation of two "once-in-a-century" hurricane in eleven years (1875 and 1886). Before the storm of 1875, Indianola was second only to Galveston in the state as a port. It had a vast influence on the development of western Texas and in the settlement, protection, and prosperity of Texas. Tens of thousands of immigrants to Texas entered here. Its wharves moved the necessities and luxuries for the people of western Texas. It was the port for trade with Mexico and the eastern terminal of the shortest overland route to California. It was the Government Depot for forts in western Texas and New Mexico. Its threat caused Houston businessmen to begin the development of the port of Houston.

The storm surge of the 1875 hurricane carried away three-fourths of the town and killed 176 people. Eleven years later the storm surge of the 1886 hurricane carried away or left uninhabitable every house in town. Indianola was never rebuilt and today the area is a state park. So widespread and devasting were the effects on Matagorda Bay of the two hurricanes, that the entire region sank into a paralyzed economic state. It took more than one half century for it to recover. This agent of change not only causes natural changes but economic, social, and changes in history too.

The hurricane is the most spectacular agent of change in the Gulf coast. It can cause short-term changes or permanent changes in a few hours. It can totally destroy and move man-made structures. The hurricanes also change the land itself.

No two hurricanes are alike. Characteristics such as rainfall distribution, tornado occurance, storm surge and wind intensities are extremely variable. Therefore, changes caused by each will differ greatly. The surge (high level of the sea) of the Great Galveston Hurricane of 1900 destroyed more than 3,600 homes and killed an estimated 6,000 to 8,000 people (the worst weather related disaster in U.S. history). Hurricane Celia (1970) destroyed an estimated $500 million worth of property and became the costiest to strike the Texas coast. Nearly all damage was a result of wind, not flooding or storm surge. Beulah, (1967) was a unique she drenched the state with its greatest rainfall and caused the most tornadoes (more than 100).

A hurricane starts a series of processes that cause change. During the hurricane's approach, reaching land and inland movement, conditions along the coast are drastically changed. Rather violent conditions may exist for a few hours to a few days.

The approach of the hurricane is marked by rising tides and increased wind. This brings large amounts of salt water into the bays and estuaries. When the storm reaches the coast, it erodes beaches and dunes. It carries sediments and salt water from the continental shelf toward the barrier islands and peninsulas. In some areas it will break over the barrier islands. The sediment which it erodes from the beaches and dunes is carried through the storm channels and spread over the mud flats and marshes and into the bays.

When the hurricane center reaches land, the currents and waves change direction. Water and sediments are now washed out from the bays into the Gulf. The highest winds are experienced as the storm moves onto land. The heavy rains from the hurricanes may cause flooding along the streams and bays with fresh water.

After the storm passes from the coastal area, the currents build sand bars across the mouths of the hurricane channels. The waves then attempt to restore the beach to normal.

The most spectacular effect produced by hurricanes, other than the destruction of man-made structures, is the erosion by the breaking waves. The waves may be as high as 40 or 50 feet when a storm covers a large area. The dunes on the barrier islands may give some protection from storm surge and waves. However, often the dunes are not high enough so the waves of large hurricanes will wash over the top of them. Large hurricanes wash over miles of land. They can also severely erode and break the barrier islands. In some places, there has been as much as 800 feet of shoreline eroded. Yes, hurricanes are spectacular and violent agents of natural change.

ONCE THERE WAS ONE, NOW THERE ARE TWO!

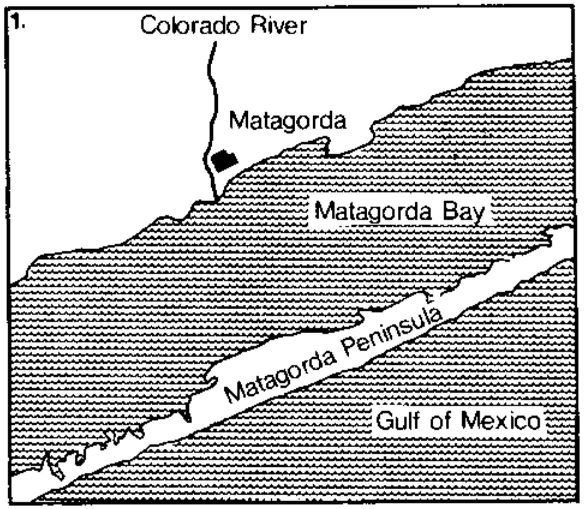
Now let's take a look at how nature changes the shape of the coastal region. If we go back in time we find that in 1856 Matagorda Bay was one bay. Drawing 2 shows the effect of a log jam at the mouth of the Colorado river in 1929.

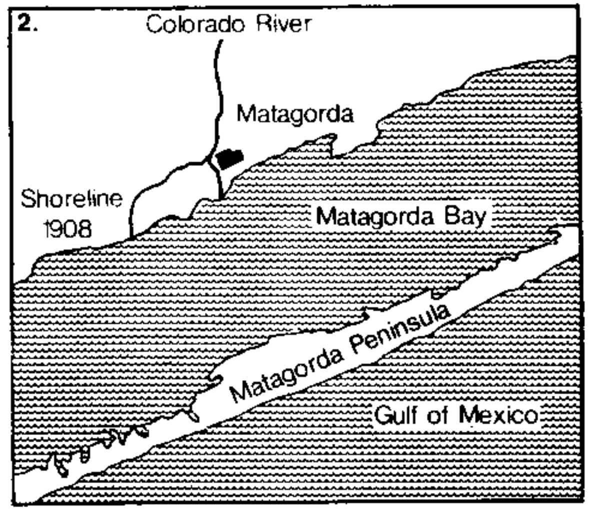
Drawings 3,4,and 5 show what happened after the log jam was removed. Three principle streams empty into the bay. The largest is the Colorado river, and we see that it has constructed a delta dividing the bay into two parts.

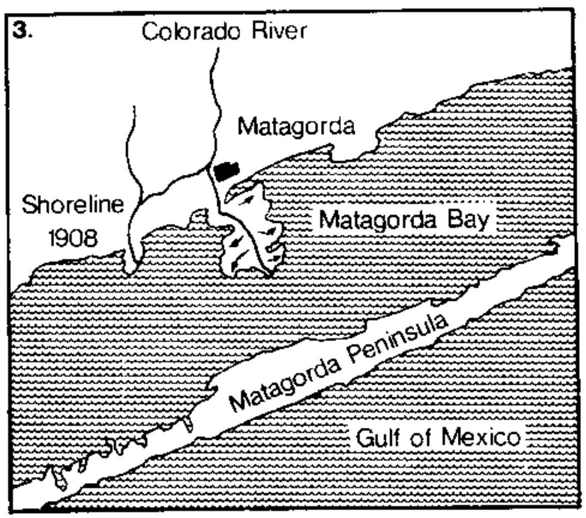
Drawing 6 shows the Colorado river mouth at the present time and mans effects on the natural processes. Water from the river enters the western bay and the Gulf of Mexico. Marshes now occupy the low-lying areas along the shore of the mainland and the bayside of the barrier islands and peniusulas. These marsh areas of the mainland are directly related to the river.

Grassflats now occur in many areas, but are best on the western side of the delta. Here, the water is a few inches to about four feet deep and the bottom is sand and muddy sand. Oyster reefs once flourished in several areas of this bay. However, some reefs have been overrun by the delta, covered by spoil from dredging, or removed by shell dredgers. There are also numerous oyster clumps in shallow water; most are dead. Therefore, nature changes not only the shape but life in the coastal zone as well.

Some of man's activities affect the natural processes of change or have the potential of doing so. These are: (1) land and water usage (2) river diversion (3) shell dredging (4) dredging of canals (5) dune destruction (6) mining of beach and barrier sand and (7) construction of jetties and bulkheads. Knowledge of the natural processes and man's activities is essential in order to insure the coastal zone will be managed wisely.

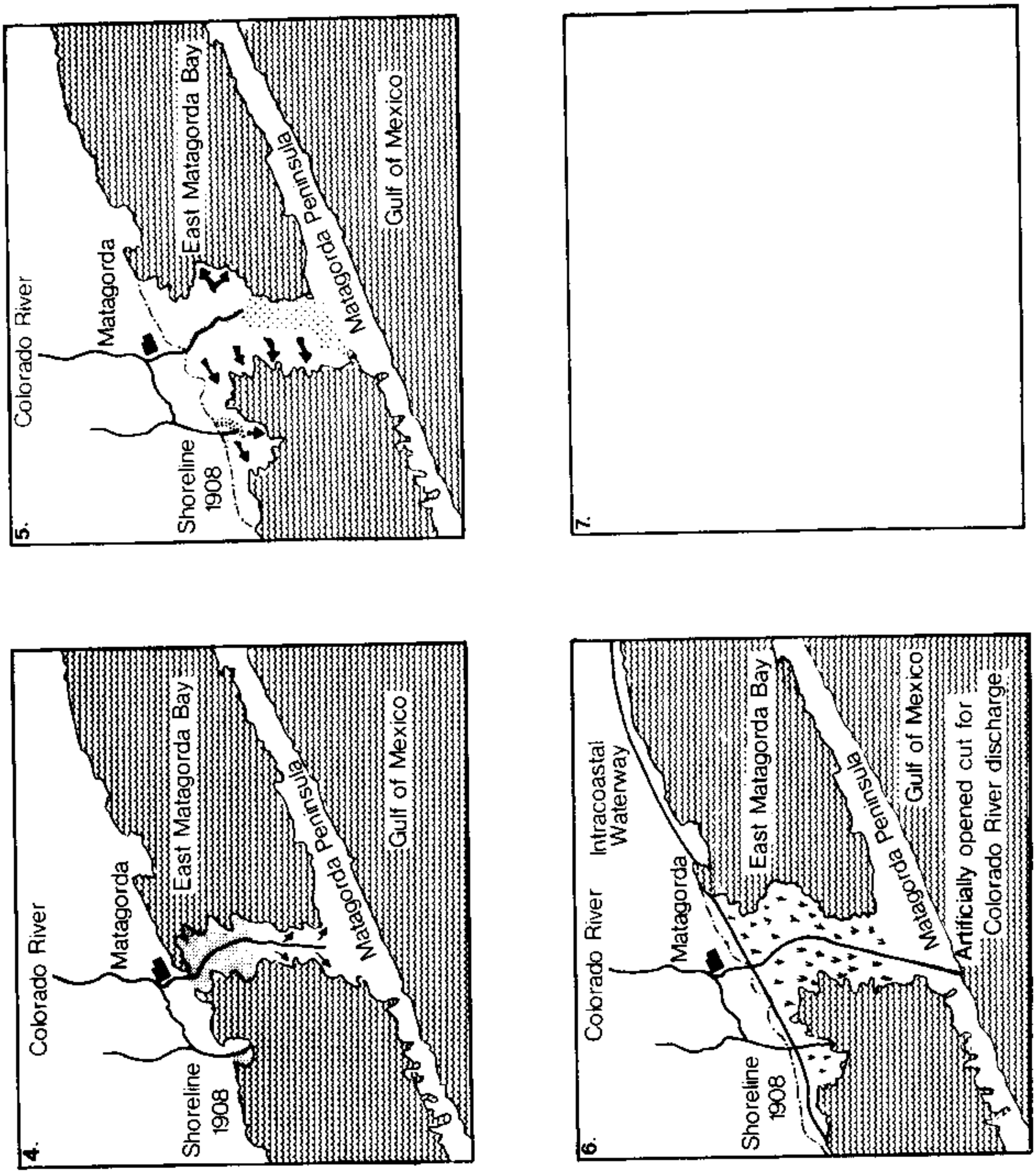






SEQENTIAL CHANGES IN MATAGORDA DELTA

1. Colorado River 1856
2. Colorado River mouth (in Matagorda Bay) in 1929, before log jam was removed.
3. Colorado Delta 1930
4. Colorado Delta 1936
5. Colorado Delta 1941
6. Schematic presentation of Colorado River mouth as it presently empties into the Gulf of Mexico.
7. Future


4.
Colorado River
Matagorda
Shoreline 1908
East Matagorda Bay
Matagorda Peninsula
Gulf of Mexico
5.
Colorado River
Matagorda
Shoreline 1908
East Matagorda Bay
Matagorda Peninsula
Gulf of Mexico
6.
Colorado River
Intracoastal Waterway
Matagorda
Shoreline 1908
East Matagorda Bay
Matagorda Peninsula
Gulf of Mexico
Artificially opened cut for Colorado River discharge
7.

QUESTIONS

1. How did the Matagorda area naturally change?

2. How would this natural change effect the marine environment?

3. How would these natural changes effect the marine organisms?

4. What effect did man have on the natural process?

5. How would man's changes effect the marine environment and the organisms living there?

6. What natural changes do you think will occur in the Matagorda area in the future?

CHANGES IN MAN'S ACTIVITIES AND THE COASTAL ZONE

LESSON NINE

ACTIVITY TWO

Read -

10,000 B.C.
4,000 B.C. to 1,000 A,D,
1520 A.D. to 1800 A.D.
1800 to 1900
20th Century-Modern Period
The Future.

Look at -

Pictures of the Texas Coast and Man's Activities Through Time.

Draw -

Your idea of the Texas coast in the future.

Divide -

A sheet of paper into five columns.
Label them:
Time Period
Natural Changes
Man-Made Changes
Impact on Envrionment by Man
Resources Used

Answer -

The questions.

10,000 B.C.--Paleo-American Period

This is Captain Seaborne. We are going back in time to look at the Texas coast. Archaeological evidence has revealed that man first came to the Texas coastal region about 12,000 years ago. This was during the time when the glaciers of the last ice age were beginning to melt. The sea level was several hundred feet lower than it is today. Therefore, the Gulf shoreline was miles further out than it is today. What today are bays were actually river valleys 12,000 years ago. Also, what we call beaches were once part of the inland prairies.

People of that time were nomadic hunters who killed all the game in one region and then moved on to a new area to hunt. They lived along rivers for water and transportation. Rivers also gave them a strategic location for hunting, since the animals were attracted to the water. These early inhabitants may have had an impact on their environment. It is thought that they used fire to stampede and kill mammoths, bisons, and other animals. As they moved about the land, they left scattered artifacts and a few kill sites that tell us of their presence. However, many of their remains are under the bay waters and in the Gulf in areas which were once dry land.

4,000 B.C. to 1,000 A.D.--Neo-American Period

By 4,000 to 5,000 B.C. melting glacier waters were causing the Gulf waters to rise to their present level. Bays, as we know them today, were in the process of being formed. Into this area moved a primitive tribe of Indians who soon adapted to the environment.

These Indians were hunters and gatherers. That is, they depended on the coastal resources in a different way than the earlier big game hunters. They began to develop social systems that are shown in their artifacts, shell middens, and burial grounds.
They probably did very little to change the environment. They had fire but no horses and no wheels. Their impact was limited to their dwelling sites. After they left an area, the land changed back to its natural state. Therefore, their impact was not lasting.

1520 A.D. to 1800 A.D.--Colonial Period

A few changes occurred in the life of the coastal Indians.

Ceramics and the bow and arrow had been introduced. Agricultural practices were probably learned from neighboring groups. At the time Cabeza de Vaca landed on the Texas coast in the 1520's most of the coastal tribes were still gatherers and hunters.

The Spanish colonial period had little impact on the coastal region, except for the territorial conflicts with the French that resulted in building Spanish missions and forts at points where the French had entered. The Spaniards occupied only a few scattered permanent settlements, mainly in and around San Antonio, Goliad and Nacogdoches. A major Spanish legacy in the coastal zone lies under water off the coast of Padre Island and beneath certain shallow bays. This legacy is the sunken ships filled with gold, silver, and artifacts of the Aztec period.

1800 to 1900 --Nineteenth Century

Mexico's independence from Spain opened up Texas to settlers. These settlers then won their independence from Mexico and established the Republic of Texas. With the forming of the Republic and later its becoming part of the United States, the coastal region became a major highway of transportation and commerce. It has remained so ever since.

Once the coastal region opened to settlement, increasing changes occurred. Ports were established. Ships brought immigrants and supplies into Texas from other areas of the United States and Europe. Some of the supplies brought in were lumber, shingles, bricks, flour, sugar, lime, coffee, railroad iron, fruits, clothing and material. The products shipped out varied from port to port. In the late 1800's, these included cotton, grain, beef, hides and tallow. The ships also carried passengers, not only between Texas ports but also to other parts of the United States.

The first steps taken to improve these ports and harbors was to dredge them. This made the waterways wider and deeper than before. Also jetties and groins were built to make the channels more permanent with fewer hazards.

Railroads were being built from these ports to the interior. Both goods and people were freely transported to and from the ports.

In 1873, the first survey was taken to find a suitable route for an intracoastal waterway. This led to the dredging operation that eventually created a channel which joined together all the existing inland waterways along the coast. This gave vessels not requiring deep water a sheltered and uninterrupted passageway through Texas from the Rio Grande on the border of Mexico to Florida.

20th Century--Modern Period

Development and expansion of the port and harbor facilities, jetties, channels and intracoastal waterway system continued. However, with the discovery of major oil fields in the 1890's and early 1900's, a new era dawned.

Today, all the major Texas ports have petroleum refineries, bulk terminals, petrochemical plants and petroleum related industries. This has caused the Texas Gulf coast region to become the world's largest petrochemical complex in terms of output and investment.

A fishing industry also developed on the Gulf of Mexico. Many ports on the lower coast are home ports for the commercial fishing vessels. The majority of these vessels are shrimpers, since 90 percent of the total fishing is for shrimp. Consequently, these ports also have ship building and maintenance facilities.

Another development that occurred in the 1920's was to play an important part in the shaping of the Gulf coastal area. The number of automobiles in the United States was rapidly increasing as the car became a mode of transportation. Motorists cast wistful gazes at the beaches of Galveston, Mustang and Padre Island. The beaches provided a highway along the Gulf for miles as well as an area for fishing, swimming, sightseeing, and pleasure driving. This led to the construction of causeways and development of ferry services to carry the automobile to these recreational areas.

This has led to the development of coastal marine recreation which includes swimming, fishing, hunting, camping, boating, sailing, surfing, golf, tennis, and bird watching. It has also led to vacation home development and hotels, marinas, restuarants, shops, etc. to serve the visitor.

In addition to petroleum, petroleum products, chemicals, minerals, sulfur, iron, steel, motor vehicles, machinery, fertilizer and etc., agricultural products also move through the ports. Agribusiness, the combined phases of food, fiber and forest production, processing, transporting and marketing, is Texas's leading industry. Agribusiness products are shipped from the coastal ports. These include corn, cotton, rice, grain sorghums, soybeans, wheat, wheat flour, animal fat, and vegetable oils.

The coastal zone continues to grow and develop. The development of offshore oil and gas production and mining and their related industries have contributed to this growth. The population of the coastal zone increased 20 percent between 1960 and 1970. What will the future be like?

The Future

What will the relationship of the Texas coast and man's activities be like in the future? There are many possibilities. Since we have no way of really knowing, we can only project possible events.

Some possibilities include:

1. running out of oil and gas
2. decrease of the petrochemical and related industries
3. fewer automobiles and boats
4. fewer people traveling to the coast for recreation
5. decrease in agricultural products due to less oil, gas and fertilizer available.
6. return to less technology
7. more mass transportation
8. greater use of solar and wind energy
9. return to sailing type ships

Some alternative possibilities include:

1. more oil and gas discoveries offshore
2. petrochemical chemical complex increases
3. a superport or two offshore for supertankers

4. offshore man-made islands with refineries and chemical plants

5. entire cities built out in the Gulf

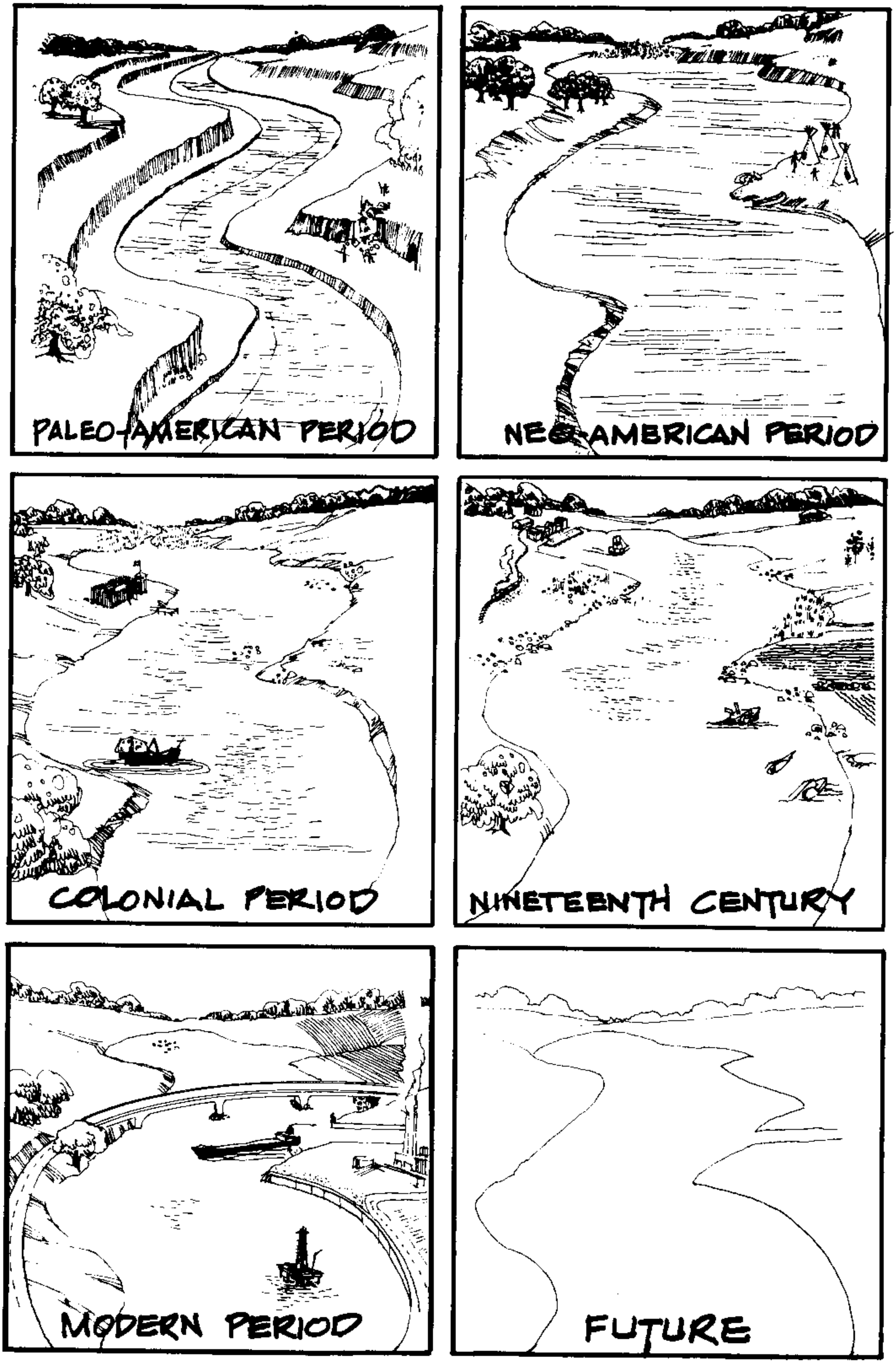
6. mariculture farms for growing algae, shrimp, oysters and fish for food

7. hydrofoil ships for transportation

8. the sun, wind and water as energy sources

The death of the coastal life zone is a possibility. The causes include dredging, coastal zone mining and drilling, tidelands real estate development, beach erosion, and water pollution. The three major water pollutants include: domestic sewage, industrial sewage (mainly chemicals), and thermal pollution. Destruction of the Gulf by pollution is a real threat since two-thirds of the natural sediments and industrial pollutants of the United States end up in the Gulf of Mexico.

What will the future of the Gulf coastal area be like? You can and will help to decide.


PALEO-AMERICAN PERIOD
NEO-AMERICAN PERIOD
COLONIAL PERIOD
NINETEENTH CENTURY
MODERN PERIOD
FUTURE

QUESTIONS

1. Compare man's interaction with the coastal environment in the 1500's to man's present day interaction. How is it similiar? How is it different?

2. Why has man's interaction with the coastal environment changed?

3. Compare man's use of resources in the past, present, and future. Why or what has changed man's use of resources through time?

LESSON TEN
WANTS OR NEEDS?

ACTIVITY ONE-Wishes, Wants and/or Needs?
ACTIVITY TWO-Past, Present and Future Needs
ACTIVITY THREE-Culture and Wants or Needs

<u>Suggested Time for Classroom Use of Materials:</u> Approximately 4 to 6 class periods

<u>Materials for Classroom Use:</u>

A Dozen Wishes-Wants or Needs?/activity
Hierachy of Human Needs/diagram
Show and Tell/activity
Advertising-Wants and Needs/activity
Karankawa-The Past/reading
Early Texas Seaport/reading
The Year 2000/activity
My World/activity
Characteristics of Culture/activity
Comparison of Cultures-Past, Present/activity
My Imaginary Culture of the Future/activity

<u>Major Objectives for the Lesson:</u> After completing the lesson, the student will be able to:

1.1 describe a culture;

1.1 list needs and wants in a given environment;

2.4 identify the needs of various organisms in a given marine environment;

2.4 analyze needs and wants in a given situation (past, present and future);

2.4 if given a situation,predict future changes in needs and wants;

2.4 if given a situation,generate factors that caused changes in needs and wants;

2.4 categorize man's needs into a hierachy of human needs;

2.4 analyze the changes in needs in different situations and thru time;

2.6 identify the common characteristics of cultures;

2.6 relate the common characteristics of a culture to his own culture;

2.6 analyze the common characteristics of culture and know that people live differently depending on their cultural characteristics;

4.3 evaluate wants and needs in terms of their relationship to the marine environment.

<u>Teaching Suggestions:</u> The purpose of this lesson is to have the students identify past, present and future needs and the relationship of culture to wants and needs. It will also help the student to analyze the factors which determine wants and needs.

1. The students will complete the readings and respond to the questions and/or activities. (The materials may be distributed on previous days.) In many cases there are no right and wrong answers.

2. The continuum (Advertising-Wants and Needs, My World, and My Position activities) might force people to choose the middle position. Defining a "ridiculous middle" can help steer participants off that position. You might define the ridiculous middle as the position chosen by a person who believes in one extreme from noon to midnight and the other extreme from midnight to noon. To share responses in the class, label opposite walls in a room with the extremes and ask participants to physically stand where their beliefs are. Or, draw the continuum on a chalk board and ask participants to initial the spots that represent their beliefs.

3. Discuss the readings and activities in small groups and/or as a whole class.

4. Encourage the students to generate related questions and then strive to answer them.

WISHES, WANTS AND/OR NEEDS?

LESSON TEN

ACTIVITY ONE

Complete -

A Dozen Wishes--Wants or Needs.

Look at -

Hierachy of Human Needs (Maslow's Pyramid).

Describe
and Present -

Your charade (show and tell) about wants and needs.

Use -

Newspapers and magazines to find ads which illustrate wants and needs.

Cut out -

Appropriate pictures, mount them on butcher paper. Label them "wants" or "needs".

Complete -

Advertising--Wants and Needs activity.

Answer -

1. What is the role of advertising in the creating of wants? How do television programs turn "wants" into "needs"?

2. What are the needs of man today-the present? List the needs.

List -

The needs of a marine organism. One student will name an organism and its habitat. The rest of the students will list needs of the organism and how environment meets those needs. Students will take turns naming the marine organism. (plant or animal)

A Dozen Wishes--Wants or Needs?

This is Captain Seaborne. I want to tell you that this is your lucky day. You have just been granted a dozen wishes. There are no restrictions on your wishes.

What are the things you would like to have?
List your wishes in order beginning with what you want first.

Compare your list of wishes with your classmates' list. Are they the same or different? Explain why they differ.

Ask what makes a thing a want or need? Use Maslow's Hierarchy of Human Needs to help distinguish between wants and needs. Write your definition for wants and needs.

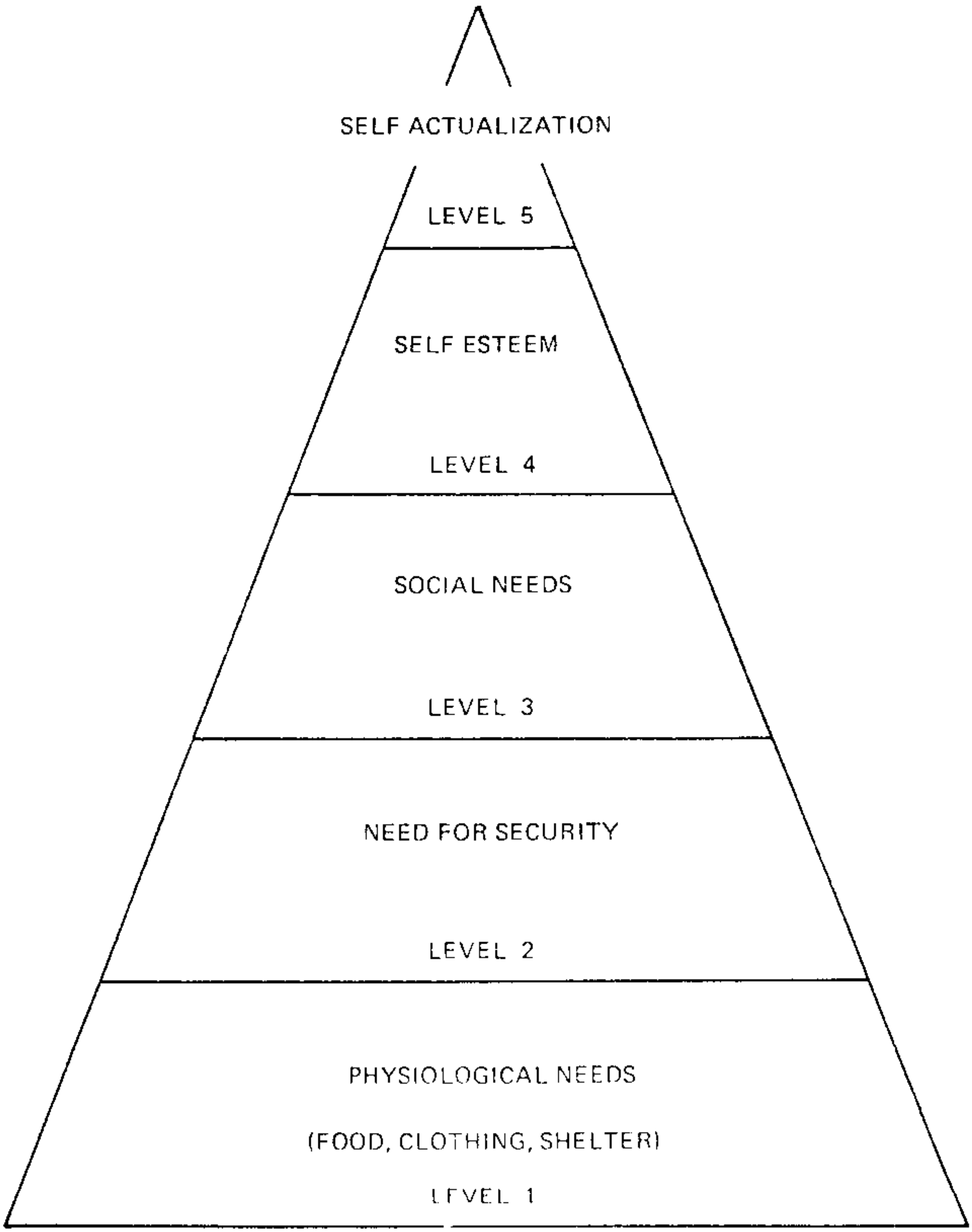
Which of your wishes are wants and which are needs? Divide your wishes into two groups: wants and needs. Place a W by those which are wants and a N by those which are needs.

What are some needs that you would want to add to your list after looking at Maslow's pyramid. List additional needs.

How does the environment meet your needs and wants?

HIERARCHY OF HUMAN NEEDS

(MASLOW'S PYRAMID)



SHOW AND TELL

Present a charade about wants or needs. (Use titles of songs, movies, T.V. shows, stories etc.)

Describe your charade.

Your classmates will try to guess the title and the particular want or need that is being illustrated by the charade.

ADVERTIZING-WANTS AND NEEDS

How much do you think advertising affects what you want and need? Put an X on the continum.

I always buy advertised goods and services.

I nevery buy advertised goods and services.

Can you think of a time that you bought something or asked for something primarily because of an ad you saw or heard?

What are some things that you need or your family needs that aren't advertised?

Why aren't they advertised?

PAST, PRESENT AND FUTURE NEEDS

LESSON TEN

ACTIVITY TWO

Read -

Karankawa-The Past.
Early Texas Seaport.

Look at -

Sketch of Karankawa
Early Texas Seaport

List -

Some differences between the needs of Indians and the early Texas settlers.

Complete -

The Year 2000 Chart.

Answer -

The questions.

Complete -

The My World activity.

KARANKAWA - THE PAST

I want to take you back in time to meet the coastal people of Texas before the Spanish and French arrived in the 1500's. They were never a large group, all five tribes never had over 500 warriors. They are the Karankawa Indians.

The Karankawa lived along the quiet lagoons. In the summers and in dry years. they would have to stay near the large waterways and move inland in search of drinking water.

They were such excellent hunters and fishermen that a neighboring tribe called them "men that walk on water." The bottoms of the lagoons were mostly smooth, and the water was shallow so they would wade out into the pools to catch a variety of fish. Fish were their most dependable food supply. At times oysters were in season as well as mussles, turtles, and porpoises. They also had ducks, geese and other birds, spiced with varieties of marine plants. Alligator meat, however, was one of their favorites.

They did well in their hunting on the nearby prairies. Deer were the common target, but they hunted javelina, buffalo and the smaller mammals too. They also ate berries and other plants. They took only what they needed.

To protect themselves against the mosquitoes, they would smear themselves with alligator grease or shark oil. This gave them an offensive odor. Their appearance was also frightening. The warriors were over six feet tall and wore onlv a breechclo . They had wild tattoos over their face They inserted bone or cane cuttings through holes in their breasts and noses for ornamentation. The men wore small shells, disks of tin, brass or other metal strapped to their throats. Their hair was coarse and dark with a reddish hue from the constant exposure to the sun.

Their main weapon was a six foot bow made of cedar, and arrows. They also had hatchets, knives, and tomahawks. They did not ride horses, but traveled on foot. The Karankawa were not only strong physically, but had endurance. They could stalk miles through the marshes and still be fresh for the chase or battle.

To add to their mobility on water, they used crude canoes or dugouts made from a large tree trunk Most of the time they did not use paddles, but propelled themselves by hand or erected a crude sort of sail out of animal skin Those could be used in the bays, but were not reliable in the Gulf, so they did not go out into the Gulf.

Their homes were round tent-like huts supported by slender willow poles. These could be set up or torn down by the women in an hour. Each held 7 or 8 people with no seats except for skins. There was a hole in the center of the top to let out smoke from the fire built in the center.

The women wore knee length skirts with deerskin bracelets on the left wrist. The children were naked and the men only wore breech clouts. When it was cold, they used animal skins for covering.

Little is known of their religion. They had a festival each full moon and after a successful hunting or fishing trip. Then there was chanting to music or a gourd filled with stones. A fluted piece of wood over which a string was drawn to produce a droning sound was used.

They had to know the territory to know when the best berries were ready to be picked and where the oysters were. They did not waste food. To live as they did, the Karankawa had to understand the environment. They adjusted to its changes and its seasons. Waste was not a part of their lives.

They were thought by some to be cannibalistic. Some evidence indicates they were not cannibalistic until they saw the Spaniards of the ill-fated Narvaez expedition eating their dead in an extended fit of hunger. Their cannibalism was only a religious rite done to prevent the individual from having another life, or for revenge and to get his powers.

EARLY TEXAS SEAPORT

When sailing into the early Texas port city, the buildings along the low shoreline stood out sharply. There were no trees, only scrub oaks. The wooden wharves which were constantly crowded, extended hundreds of feet out into the Gulf. There was a railroad leading up to wharves.

The warehouses, built of cypress lumber, were the largest structures in town. They were located between main street and the shoreline. In these warehouses, merchandise taken from ships or to be loaded onto ships was stored temporarily. The unpainted cypress warehouses, small sheds and fences were weathered beautifully, giving them a coloring of silvery gray.

The early homes were cottages, but by the 1850's fine, two story board homes had appeared. Usually they were painted a glossy white. Shutters were used on homes and commercial buildings for coolness. The shutters also helped to reduce the glare produced by sunlight reflected off the white shell and sand on which the town was built.

It was a resort area for fishing, crabbing and bathing. The "moneyed class" from upstate were attracted by the fresh sea breezes. The hotels had constructed short piers for the exclusive use of their patrons. The boundless variety of seafood was a gourmet's delight.

The children collected sea shells, coral fragments, live conches, bits of floating pumice and driftwood. The ladies would sit in the shade of the hotel galleries to exchange gossip.

The port city was supplied with ice harvested on New England ponds in mid-winter and shipped south in refrigerated ships. Once it arrived in the port city, it was packed in an ice house which had thick wooden walls insulated with saw dust. So natural ice was available for home use, hotels, restuarants, bars, drugstores and confectionaries where ice cream and chilled drinks were sold.

It cost next to nothing to live in the early coastal port. Fish, crabs and oysters were abundant. All kinds of wild game (ducks, geese, deer, etc.)were available. The people were welcome to all the fresh beef they could carry from the slaughter houses.

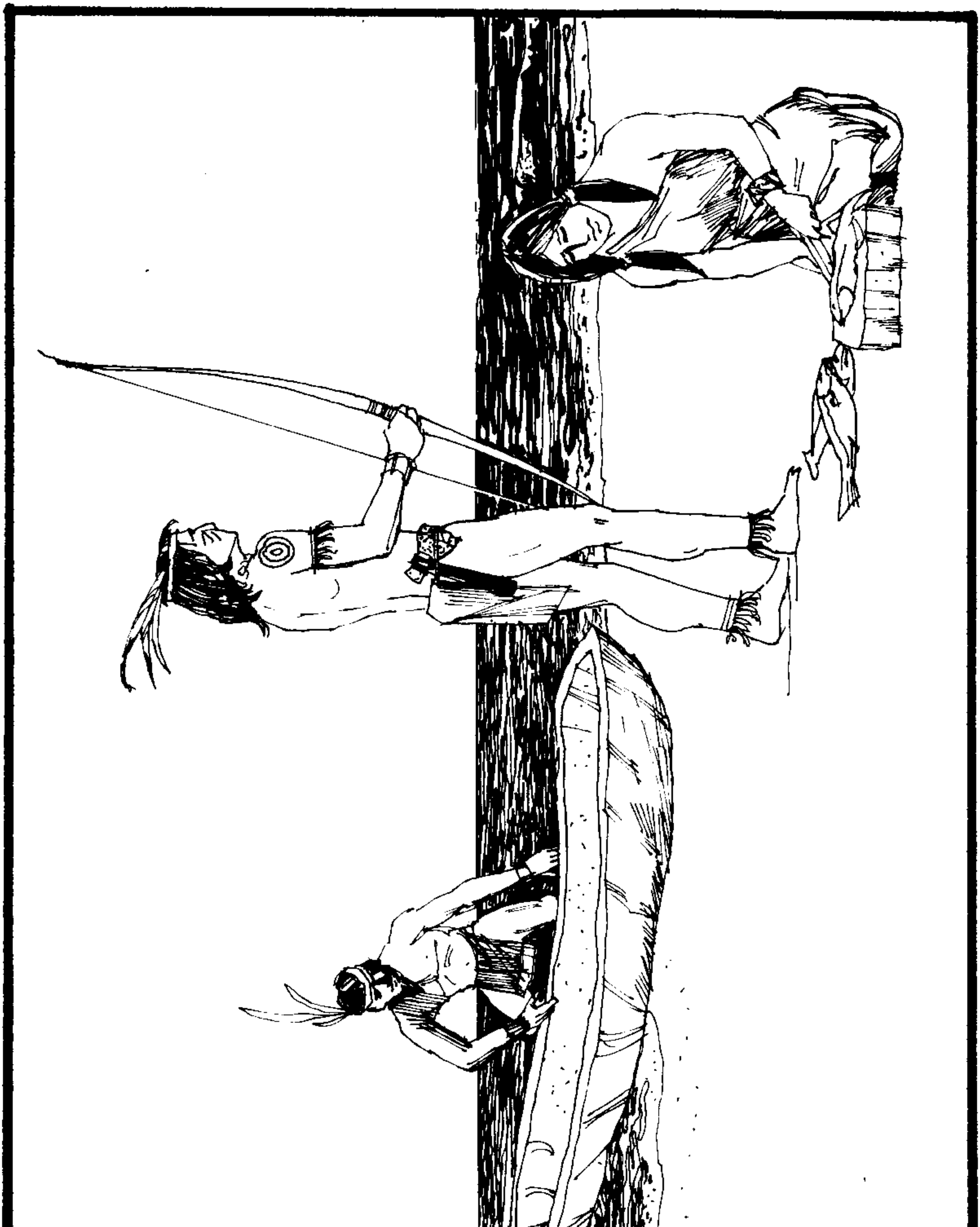
There were nearby concerns in the wholesale slaughter of cattle. The cattle were driven into chutes and killed and skinned. The butchers had no use for the carcasses after the hides and tallow were removed. Therefore, town people could have all the fresh meat they wanted. The carcasses were then hauled outside the town limits. They were left there for hogs, birds, and beasts of prey to eat. The hides and tallow were shipped to the eastern U.S.

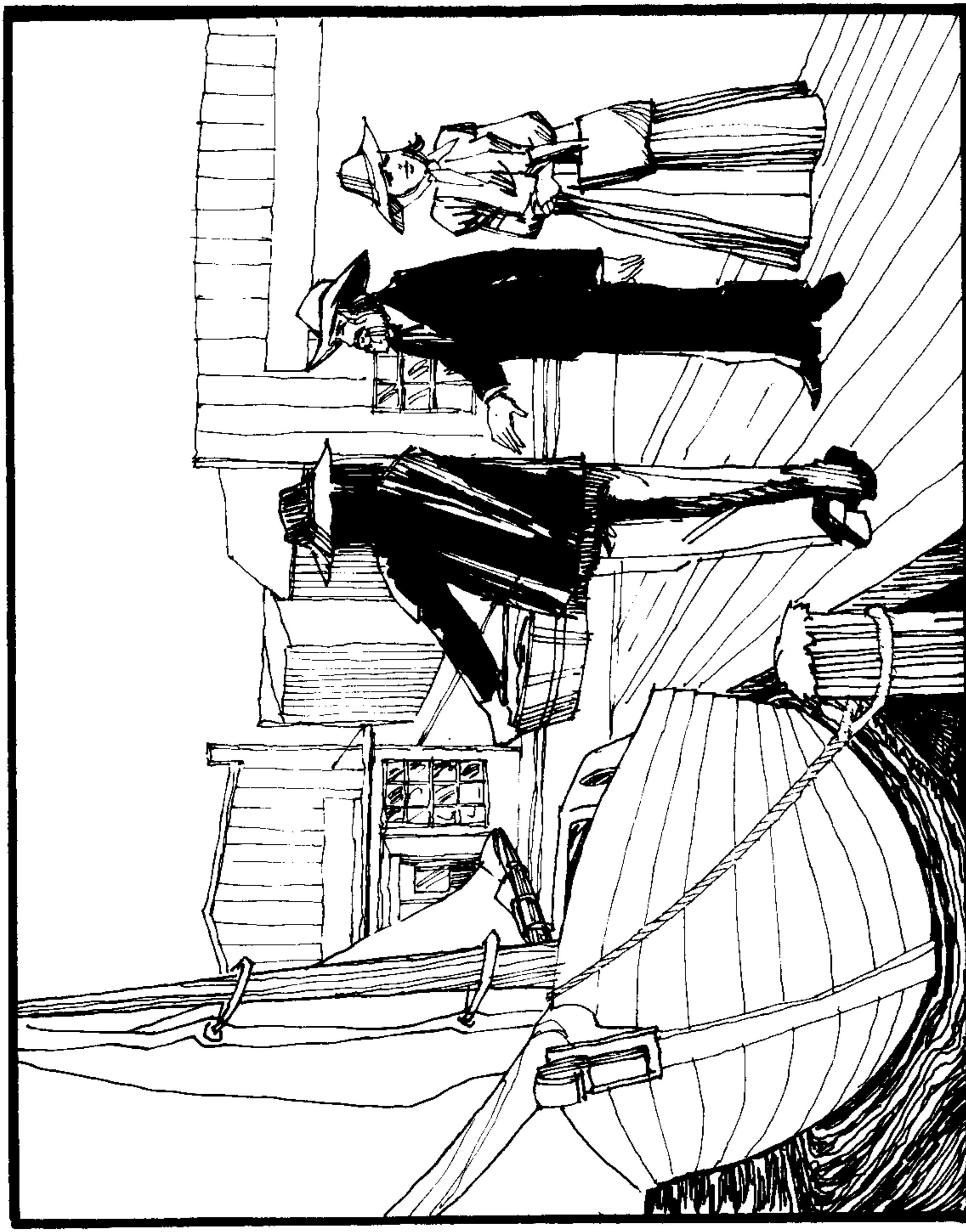
It was not unusual to see herds of cattle driven through town to the slaughter houses or to the wharves. At the wharves, the cattle were loaded on board ships. They were shipped to New Orleans, Cuba and the eastern U.S.

There was also a turtle factory. The large sea turtles were caught in nets and brought to the factory to be canned. Once canned, theywere shipped to all parts of the world.

These seaports served as ports for almost all the country west of the Colorado River to the Rio Grande in Texas. Three ships a week arrived from Galveston and two from New Orleans. They were all sailing ships until the side-wheel streamers in 1859-1860. They brought necessities and luxuries for the inhabitants of western Texas, New Mexico and a large part of the southwest. Immigrants from Germany, Switzerland, France and also the southern and eastern U.S. arrived on the ships. Thousands of bales of cotton were shipped from the port along with the cattle tallow and hides. Wool and pecans were also shipped out.

Large wagons called Prairie Schooners drawn by 10 to 12 oxen and two-wheel Mexican carts drawn by a yoke of oxen or 6 mules came and went by long trains. Wagons of Wells Fargo Express Company drawn by 16 mules brought silver bullion from Mexico to be shipped to the mint at New Orleans. These wagons were heavily guarded. A stage coach left for California twice a week. Early Texas ports were definitely busy and an important commercial link.





1. What were the needs of the Karankawa? List their needs.

2. What were the wants of the Karankawas?

3. How did the environment meet their needs and wants?

4. How did the Karankawa interact or affect the marine environment?

5. What resources did the Karankawa use? How did they use them?

6. What do you think are some things that are important to them? How is this different from your life?

7. Was there a difference in the wants and needs of the Karankawa as compared to the early Texans?

8. What were the reasons for the differences between the needs of the Indians and the early Texas settlers?

THE YEAR 2000

The year 2000 or the 21st century is part of your future. How old will you be then? Most of us dream about the future once in a while. In this activity you will create your life in the year 2000. It can include whatever you want. What do you think it will be like?

In the chart below describe how you see each of the following in your future in the year 2000. Fill in the things you want and need.

	Description	Wants	Needs
your family status			
location of home			
description of your home, building, rooms			
your job			
location of job			
transportation you will use			
food you will eat			
forms of recreation			
clothing			
how you will spend your leisure time			
other			

1. What will be your needs in the year 2000?

2. What will be your wants in the future you described?

3. How will the environment meet your needs and wants in the future?

4. How will your needs and wants effect the marine environment in the future?

5. What are the differences between your present needs and wants and those of the year 2000?

   Why are there differences?

6. Why do wants and needs change through time?

MY WORLD

Where would you like your world to be on this continuum? Make the spot with an X. Where is your personal world? Put a Y on that spot. Ask some people you know to put their initials on the line where they would like their world to be.

Karankawa Indians	Early Settlers	Today	2000 A.D. Fully Automated

"Think" your answers to the following questions: Do most of the world's people live in the right half or in the left half of the continuum?

People in what parts of the world might live in the left half of the continuum?

In which half of the continuum do you think most people live?

Might some people choose to move from the right half to the left half of the continuum?

LESSON TEN

ACTIVITY THREE

Complete -

Characteristics of Culture.
Comparision of Cultures-Past, Present.

Dream up
and answer -

An imaginery culture of the future.

Develop -

Your Imaginary Culture of the Future.

Complete -

The My Position exercise.

CHARACTERISTICS OF CULTURE

Ask--What is meant by the word culture?

To help decide, lets look at some common characteristics of culture.......

1. Food
2. Shelter
3. Clothing
4. Tools
5. Music and Dance
6. Arts and Crafts
7. Beliefs
8. Behaviors

If you know some of these things about a group of people, you can decide about the culture.

Think about your culture or some of the characteristics listed above that you know about in your life.

Write a poem or a group of sentences describing your culture. Now that you have some ideas on paper, draw a picture that you think shows some things about your culture.

COMPARISON OF CULTURES-PAST, PRESENT

Think about the culture or some of the characteristics of culture that you know about the Karankawa Indians or the early Texas settlers. You may want to refer back to activity two as a reference. Now that you have some idea about their culture, write a short story or produce a skit describing a day in the life of a Karankawa Indian or an early Texas settler who is your age.

Answer

1. How do the cultures of the Karankawa , early Texas and today differ?

2. What resources did the Karankawa Indians or early Texas settlers use?

3. How did they use the resources?

4. What are some things they each seem to value or are important to them?

5. How is this different from your life?

6. Why is it different from your life?

MY IMAGINARY CULTURE OF THE FUTURE

Develop an imaginary group in your mind that (A) lives in, on,or near a marine environment (B) in the future--25 years from now

List the group's cultural characteristics based on common characteristics of culture.

Decide how these people will survive, what they will need for a "successful life" in an imaginary marine environment you describe.

Draw pictures showing resources used by your imaginary group.

Share imaginary cultures with your classmates.

LESSON ELEVEN
INTRODUCTION TO MARINE RESOURCES

ACTIVITY ONE-What is a Resource?
ACTIVITY TWO-Marine Resources-Introduction
ACTIVITY THREE-How do They Rate?

Suggested Time for Classroom Use of Materials: Approximately 3 to 5 class periods

Materials for Classroom Use:
What is a Resource?/activity
Audio tape and slides titled "Marine Resources"
Marine Resources-Introduction/activity
How do They Rate?/activity
What do You Think?/activity

Major Objectives for the Lesson: After completing the lesson, the student will be able to:

1.1 define resource;

1.1 point out resources of the marine environment;

1.1 classify marine resources as renewable or non-renewable;

1.1 categorize marine resources as to their value-monetary, ecological, cultural, aesthetic, recreational or historical;

1.1 discuss people as a resource.

Teaching Suggestions: The purpose of this lesson is to have the students identify marine resources and to group them as renewable or non-renewable. The students will also determine the value of the resources.

1. Have the students complete the activities.

2. Show the slides/audio tape.

3. Discuss the activities in small groups and/or as a whole class.

4. Optional--Students may select a marine resource to research on its past, present and future usage and become an "authority" for the class on that resource. You may have the student(s) help you present information when his particular resource is presented in the following lessons.

5. The students will understand that all of the knowledge they are acquiring is directed toward the culminating activities. The two activities are:

    1. Simulation: Shoreview in which they each will play a member of the community Shoreview which is developing a plan for the future of the city and the use of its resources.

    2. Planning and setting up an exhibit for the International Sea Exposition. Their section will present the importance of the sea with emphasis on the Gulf of Mexico.

WHAT IS A RESOURCE?

LESSON ELEVEN

ACTIVITY ONE

Determine -

The resources required for wants and needs.

Classify -

The resources as renewable or nonrenewable.

Answer -

The questions.

WHAT IS A RESOURCE?

Divide a sheet of paper into 3 columns.
Label them:

Needs & Wants, Resource, Nonrenewable or Renewable Resources

List your wants and needs from the previous activity in the first column.

In column two list the resources.
Now we will go through the list and decide the resources needed for the needs. We will define resources as the materials needed for the satisfaction of wants and needs.

Determine if a resource is renewable or nonrenewable. Use the definitions below to decide.

> Non-renewable Resource--if to the best of your knowledge there is only a fixed amount of the resource in or on planet Earth, or if it is a mineral, then it should be classified non-renewable.

> Renewable Resource--If to the best of your knowledge the resource can be grown or in some manner replenished from year to year or is a plant or animal, then the material should be classified as renewable.

When the definitions are clear, go through your list of resources and write R for renewable or N for non-renewable in column three. If you are in doubt about any resource then take your best guess and put a question mark (?) beside it.

Answer

1. Do you need more renewable or non-renewable resources?

2. Look at your list of needs and wants in the Future, will you be using more resources in the future? Will you need more renewable or non-renewable resources?

MARINE RESOURCES

LESSON ELEVEN

ACTIVITY TWO

Write -

A definition for marine resources.

Brainstorm
and list -

All marine resources.

Share -

Your lists with your classmates.

Listen to -

Audio tape on marine resources.

Look at -

Slides on marine resources.

Classify -

The marine resources as renewable or non renewable.

Check -

The marine resources you use.

Share -

The marine resources you use with your classmates.

Answer -

The questions.

<u>Optional</u>

Select -

A marine resource to research. You will be the class expert on that resource. Determine its past, present and future importance.

Present -

The information on the resource you selected to the class.

MARINE RESOURCES-INTRODUCTION

What is a marine resource?
Write your definition for marine resource.

Let's Brainstorm

Purpose: To make a list of a large number of marine resources.

(instructions for brainstorming)
See Lesson One

Compare and share your lists.

Look at slides and listen to tape on marine resources.

Add those marine rescurces which you had not thought about before the slides and tape to your list.

Group your list of marine resources as renewable or non-renewable resources, placing a R by those which are renewable and a N by those which are nonrewable. If you are in doubt about any resource then take your best guess and put a question mark (?) beside it.

Determine which marine resources you use. Place a check mark next to the ones you use.

Compare your use of marine resources with your classmates uses.

Answer:

1. Do you use more renewable or non-renewable resources?

2. Which marine resources that you have not used do you think you might use in the future?

3. Does everyone in your class use the same marine resources? Why or why not?

MARINE RESOURCES

Slide 1:
Background music.

Slide 2:
Background music.

Slide 3:
Background music.

Slide 4:
Greetings Mates! I'm Captain Seaborne. Thank you for inviting me to speak to you again. This time I will be talking about another one of my favorite topics--Marine Resources.

Slide 5:
We will define resource as things needed to satisfy our wants and needs.

Slide 6:
In many ways, both large and small, the resources of the sea affect our lives. Even as we examine the clouded crystal ball with which we predict the future, we see a great many ways the sea will influence our tomorrows.

Slide 7:
The sea provides us food so long as we have lived on its shores. We consume an average of more than eleven pounds of seafoods per person annually. With the realization that fish and shellfish contain no saturated fats, and supply are high-grade protein and other essential minerals has contributed to a slow increase in consumption. Actually we use more than five times as much seafood for fishmeal in feeds for poultry and land animals.

Slide 8:
The sea contains millions of species of plants and animals. There are more than twenty thousand species of fish alone. A great many marine organisms have been used for food, but a very small number of them are eaten in large quantities. For example most of us would not eat sea urchins.

Slide 9:
While it is certain that the food resources of the sea are not totally used, no one knows exactly how large these resources are. We do know, however, that overfishing has taken its toll. At least twenty of the more popular species are close to or have been overfished.

Slide 10:
The overwhelming proportion of food from the sea (approaching ninety percent) consists of fish. Plants from the sea provide

less than one percent of man's food--compared to the figure of eighty percent for land plants in some parts of the world.

Slide 11:
The role of plants in the marine environment is enornous. The abundance of marine animals is determined by the ability of the region to grow plants. Although we do not eat many sea vegetables, it is very difficult for us to get through a day without coming in contact with products made with the help of a seaweed colloid or gelling compounds. Uses range from bakery items, dairy products, meats, soft drinks to industrial applications like the tires on our cars.

Slide 12:
In future years, it is likely that we may see rows of man-made ponds along the coast. These ponds will contain marine organisms like salmon, perch, mullet, shrimp, crab, lobster, algae and others. These will be mariculture ponds for raising marine organisms. Or, there may be farms out in the ocean itself. Mariculture could tremendously increase our food supply thus creating a blue revolution.

Slide 13:
In the future a large portion of our energy production will also be oceanic. We do not know the size of the oil reserves and in particular those which are in the deeper parts. The end of our oil age will actually take place when the reserves of the deep parts of the ocean are exhausted.

Slide 14:
Uses of energy from the ocean has taken many forms and will take many more in the future. Such energy sources include wind, waves, tides, thermal and nuclear fusion.

Slide 15:
Initially a major resource of the ocean was transportation. The seas permitted large quantities of materials, abundant in one place, to be moved with little use of energy to places where they were scarce. Today, we have tankers and supertankers carrying hundreds of thousands of tons of oil from the oil-soaked Middle East to the oil starved coasts of the United States.

Slide 16:
Located in these coastal regions of the United States are channels, harbors, docks and other facilities associated with water transportation and shipping.

Slide 17:
One of the great phenomena of our time is an increase in marine recreation. This has taken place gradually and its most noticeable by the clogged highways and waterways during weekends

and vacation times.

Slide 18:
The attraction of the water has led to crowded beaches...

Slide 19:
with scarcely a square yard of sand unoccupied and the salt smell of the seashore complete lost in the haze of sun-tan lotion.

Slide 20:
Recreational activities range from pleasure driving along the coastal highways paralleling the shoreline and spanning the bays and channels...

Slide 21:
to lounging, sunbathing, girl-watching...

Slide 22:
beachcombing, and building sand castles along the beach.

Slide 23:
There are also the water contact sports of surfing and swimming.

Slide 24:
Recreation is a highly visible and obvious example of the social values of marine environment. There are economic values, too; next to offshore petroleum and gas in economic impact is recreation.

Slide 25:
While we travel to our favorite outdoor spot, we enjoy motoring along coastal highways and upon arrival settle in motels for the night...

Slide 26:
or camp out.

Slide 27:
We patronize restaurants, service stations, bait shops, marinas and other businesses that cater to our recreational needs.

Slide 28:
Within the sea itself, we find many minerals useful to man. For example, gold, silver and diamonds are mined from the ocean depths. Clam and oyster shells are mined as a source of lime and building materials.

Slide 29:
The ocean has generated and is generating deposits of manganese, copper, cobalt, nickel, and titanium in unique potato-like rocks calles manganese nodules. Actually all of the minerals

of land appear in the oceans in concentrated quantities which are generally larger than their land counterparts. Therefore an increasing percentage of the world's minerals will be obtained from the sea. The question that must be answered is who owns the resources of the oceans and how will those resources be managed and distributed.

Slide 30:
The sea is also a source of medicine. There are hundreds of poisonous marine organisms each one having toxins that have potential as a drug. For example, the toxins from jellyfish, hydroids, sea cucumbers and sea anemones that cause paralysis have the greatest potential for becoming drugs for heart and muscle diseases and even a possible cancer cure. However, if we are not careful, we will destroy this medical gold mine with pollution.

Slide 31:
We have always been attracted to shells and fascinated by their beauty. Shell collecting has led to hundreds of shell shops around the world. However in some areas, shell animals no longer exist because of being collected for their shells.

Slide 32:
Red coral has always been valued for its beauty. As coral becomes more scarce, the value of this resource increases. Red coral is almost as expensive as gold. Today, dredges are used to remove coral. If this continues coral will soon be a souvenier of the past.

Slide 33:
The coastal zone is the nesting, resting and feeding site for many species of waterfowl. Every year, many days are spent hunting for ducks, geese and other waterfowl in this area.

Slide 34:
The endangered whooping crained winters in a Texas estuarine zone; the muskrat, mink, swamp rabbit, white-tail deer and other game and fur bearing animals use it also.

Slide 35:
Gulls, pelicans, roseate spoonbill and other migratory as well as resident species of birds use the area and are a source of enjoyment for bird lovers and photographers.

Slide 36:
The sea is a rich source of knowledge and we still have much to learn. It is helping us decipher the origin of the earth and the geological events which followed. Marine organisms are providing us with some vital research tools. The knowledge the sea can provide us is limited only by our own abilities.

Slide 37:
The surface of the coastal zone is the site of beach cottages and housing developments. Many are built on landfills in the estuarine zone.

Slide 38:
The coastal zone is also a favorite site for industries and chemical plants since abundant water is available for the manufacturing processes and the disposal of wastes.

Slide 39:
The surface of the sea itself is a natural resource for a space-starved land. Using the ocean surface away from the land for power plants, airports, industrial complexes, resorts and even cities the threat of destroying our coastal estuaries is greatly reduced. In the future we will even utilize the underwater area for research, farming, recreation, work and living.

Slide 40:
Among the resources of the sea, the most priceless is the water itself, and in the future it may well be the most important resource recovered from the sea. Over much of the world, water shortage is a grave and growing problem. The time may be approaching when a drop of water will cost more than a drop of oil.

Slide 41:
Our coastal zone with its bays, tideflats, bayous, lagoons or marshlands is one of our most valuables natural resources. They are more productive than our richest cornfields. An estimated ninety-five percent of all fish and shellfish landed by sport and commerical fisherman along the Gulf coast depend upon the estuarine zone during some period of their life cycle.

Slide 42:
Miles of sandy beaches and their organisms also draw countless numbers of people.

Slide 43:
Jetties and groins were made to control the movement of sand along the shore and are the rocky shore of the Gulf coast. They provide an environment where marine organisms that attached to rocks can grow and live. They also provide an arena for pleasure. The activities range from fishing, crabbing, sunbathing to just enjoying a walk.

Slide 44:
Crabs, barnacles, jellyfish, sand dollars, seaweeds, sea oats and many other creatures are part of the marine environment. These all add interest, beauty and aesthetic appeal and attract millions of people.

Slide 45:

The greatest joys are those of the heart and the sea is a tremendous resource for aesthetic joy. It can nourish not only the physical being but the spiritual being as well. We need this chance in our lifestyle.

Slide 46:

Each use of marine environment satisfies someone's need or desire. Uses and alterations of the sea that jeopardize the marine resources must be controlled to insure the benefits of these resources for future generations. The marine resources are the common heritage of all manking. The destiny of all mankind is inevitably dependent on the responsible development, both environmental and economic, of the marine environment and its resources.

Slide 47:

Well mates, it's been a pleasure visiting with you. I'm looking forward to sharing some more about the marine resources with you in the activities that follow. Any questions?

Slide 48:

The end.

HOW DO THEY RATE?

LESSON ELEVEN

ACTIVITY THREE

Determine -

The value of marine resources in "How Do They Rate?"

Share -

Your ratings with your classmates.

Answer -

The questions about the ratings.

Complete -

The "What do You Think?" activity.

HOW DO THEY RATE?

Determine the value of the marine resources. We will define value as something that is important in man's existence. Use the right hand side of your marine resource list to code the marine resources as to their value in the following way:

A dollar sign ($) to be placed beside any item which is of economic or monetary value.

The letter E to be placed beside any resource which is of ecological value.

Which resources are of cultural value? Code them with the letter C.

Mark with an A any resource which is of aesthetic value.

Put the letter R next to any resource which is of recreational value.

Next to the resources that are of historical value write the letter H.

Resources may be coded with more than one letter.

Answer:

1. Did everyone rate the resources in the same way?
2. Why are resources rated differently by different people?
3. Which value do you feel is most important and should be used as a basis for deciding how a resource is to be used?

WHAT DO YOU THINK?

Do you think that we are likely to have enough energy, food and other resources for our needs in about 25 years?

Your answer:

Your reasons:

YOU

What is your forecast for the future?

YOU

LESSON TWELVE
LIVING MARINE RESOURCES

ACTIVITIES 1-5

Suggested Time for Classroom Use of Materials: Approximately 9-11 class periods

Materials for Classroom Use:

Are You a Sea Food Connoisseur?/activity
A Diner's Delight??/reading & questions
Sea Food Fair Taster Report/activity
It's Good For You!/reading
FPC/reading
Fish As Animal Feed
Living Marine Resource Surveys
- Supermarket survey
- Restaurant Survey
- Health Food Store or Oriental Food Store Survey

Those All Important Seaweeds!!!/reading
Read the Labels/activity
Fishing in the Past/reading
Fishing--Today/reading
Texas Fisheries/reading
Where Have All the Fish Gone?/reading
Fishing Laws and Regulations/activity
Housing Shortage/reading
A Blue Revolution?/reading
The Future--Scenario A/reading
The Future--Scenario B/reading
Buttons/activity
Newspapers, Magazines
Scissors, glue
Coloring & writing materials
*Sea Foods
*Sea Vegetables
*More information in teaching suggestions

Major Objectives for the Lesson: After completing the lesson, the student will be able to:

1.1 cite examples of living marine resources;

2.3 evaluate a living marine resource problem man has solved and the changes that resulted and the new problems that arose;

2.5 if given a living marine resource, to reconstruct its relationships in the marine environment;

2.5 generate a list of living marine resources that will be important in the future;

2.5 identify the living marine resources which are utilized to produce consumer products and services;

2.5 identify the consumer products produced from living marine resources;

2.6 explain and categorize ways in which living marine resources were used in the past and are being used;

2.6 analyze the use of a living marine resource through time in relation to the values involved and availability;

2.6 describe how the changing use of living marine resources has changed lifestyles;

2.6 compare and contrast the use of living marine resources in different cultures;

2.6 identify and clarify his own value position in relation to living marine resources;

2.6 analyze value positions in relation to living marine resources to determine similiarities, differences and possible conflicts;

2.7 formulate possible future uses of living marine resources;

3.1 evaluate marine environments on basis of man's capacity to manage them;

3.1 discuss the interplay of the many facets (sociological, economic, governmental, psychological and moral) in man's management of the living marine resources;

3.2 describe and identify situations where technology has caused a change in the use of a living marine resource through time;

3.3 if given examples of living marine resources acquisition, to evaluate what considerations are important;

3.3 analyze which factors were most important in decision making and how circumstances may change in light of altered circumstances;

3.3 identify a situation in which short term economic gains may produce long term environmental losses;

3.4 make projections about the future consequences of man's manipulations of the marine environment;

4.1 identify false expectations about living marine resources;

4.1 appraise their attitudes toward familiar and unfamiliar living marine resources;

4.1 understand that values influence people's use of living marine resources.

Teaching suggestions: The purpose of this lesson is to introduce the student to the living marine resources and their products in past, present and projected future. He should also learn about acquisition and use of the resources. He should begin to form ideas relative to how man can analyze the actions that he takes in terms of how those actions will affect the marine environment and how in turn the change will affect man.

Readings, activites and higher order and value clarifying questions and/or activities are used.

1. Have the students complete the readings and respond to the questions and/or activities. (Readings may be distributed on the previous day.)

2. In the "Are You a Sea Food Connoisseur?" activity, defining a "ridiculous middle" can help steer participants off that position. Share responses in small groups and/or with the whole class.

3. The "Sea Food Fair Taster" activity is designed to give the students the opportunity to taste foods from the sea. Many people, however, have a psychological barrier against eating many kinds of sea foods, even if they have never tried them. For example, algae

flavors are not salty or fishy as might be expected; some might be described as beanlike, nutlike or even remind one of celery, parsley or grapes. In this activity, the students will have the opportunity to taste various seafoods in an attempt to counter such attitudes.

You may do this jointly with the Home Economics department, the cafeteria, parents of students, Community Young Homemakers organization or in high school the students themselves may make the dishes and bring them to school. (Check school policies) Local seafood restuarants may even help. Check it out, they can only say yes or no. Those involved in preparing the dishes should keep the ingredients of their dishes secret. Identify the foods only by number until after the tasting. Do not discuss the ingredients before the tasting.

Sources of food items:
sea vegetables or seaweeds, already prepared items made of algae--available at Oriental Food Stores or health food stores

seafood--canned and frozen--supermarkets, seafood restaurants, and fish markets

FPC--fish protien concentrate--samples available from: Population Environment Curriculum Study, 310 Willard Hall, University of Delaware, Newark, DE 19711.

The majority of the health food stores carry dried sea vegetables, agar. Some of these are kanten, dulse, wakame, konbu, laver, and agar. They will also have some recipes available.

Possible Sea Food Fair Memu:

Appetizers -	Fried Sweet Kelp Chips
	Sea food Cheesies*
Soup -	Hearty Soup
	Dulse Soup
	Soup with slivered Kombu
Salads -	Kanten Salad
	Wakame, Cucumber, and Radish Salad
Entrees -	Various fish, shrimp, crabs, oyster, clam, mussels, and other shellfish

* The following and many other recipes are available free from: Texas Parks and Wildlife Department
Seafood Marketing Services
4200 Smith School Road
Austin, Texas 78744

Shark Teriaki Kabobs
Shark Steaks with Fruit Sauce
Savory Baked Drum Fish
Festive Mullet
Spicy Pan Fried Croaker
Golden Croaker in Coral Sauce
Red Snapper en Papilote
Sweet and Sour Redfish
Blue Crab Omelet
Crab Au Gratin
Golden Fried Oysters
Broiled Rock Shrimp Tails
Shrimp Hurry Curry
Seafood Creole
Seafood Bisque
Seafood Cheesies
Also free poster <u>Where There's Fire There's Smoke</u>
A new method of fish cookery.

Desserts - European Apricot Candy
Lime Agar Dessert
Shimmery Apple Cider Gel
FPC-Chocolate Chip Cookies
FPC-Cinnamon Cookies
FPC-Bread

Beverages - Hot Dulse Lemonade
Yogurt Drink

RECIPES

The following FPC-wheat flour mixture can be made at home and used in recipes:

4 1/2 pounds (or 18 cups) of all-purpose flour
1/2 pound (or 2 cups) of FPC

Mix the all-purpose flour and the FPC, sift several times and store in an airtight container. This supplemented wheat flour mixture can then be used in the recipes that are given below or in other recipes that require wheat flour.

FPC-CINNAMON COOKIES

1/2 cup vegetable shortening
1/2 cup butter or margarine
1-3/4 cups sugar
2 eggs
2-3/4 cups sifted FPC-flour
2 teaspoons cream of tartar
1 teaspoon soda
3/4 teaspoon salt
2 teaspoons cinnamon

Mix shortening, butter, 1 1/2 cups sugar and eggs thoroughly. Combine and sift flour mixture, cream of tartar, soda and salt. Stir dry ingredient into shortening-sugar mixture. Chill 1 hour. While dough is chilling,mix remaining 1/4 cup sugar and cinnamon. Shape rounded tablespoonfuls of dough into balls. Roll balls in cinnamon sugar. Place 2 inches apart on ungreased baking sheets. Bake in moderate oven, 350°F. about 10 minutes or until done and lightly browned. Cookies will puff up then flatten. Remove from baking sheet and cool on racks. Makes about 40 2-1/2 to 3-inch cookies.

FPC-CHOCOLATE CHIP COOKIES

2 3/4 cups sifted FPC-flour
1 teaspoon soda
1 teaspoon salt
1 cup butter or margarine
3/4 cup brown sugar
3/4 cup granulated sugar
2 eggs
1 1/2 teaspoons vanilla
2 packages (6 ounce) chocolate chips
1/2 cup chopped pecans, if desired

Combine and sift first 3 ingredients; reserve. Cream butter or margarine, sugars, eggs and vanilla until smooth and fluffy. Stir dry ingredients into creamed mixture. Add chocolate chips and nuts; mix well. Drop level tablespoons of dough 2 inches apart on ungreased baking sheet. Bake in moderate oven, 375°F., about 10 minutes or until done and a golden brown. Remove cookies from baking sheet and cool on racks. Makes about 72 2-inch cookies.

FPC can be used in soups. In the following recipe FPC is used to make light, fluffy dumplings.

HEARTY SOUP

1 tablespoon butter
1/2 cup flour/FPC mixture
(8 parts flour to 1 part FPC)
1/4 teaspoon baking powder
1 egg
1 tablespoon parmesan cheese
6 cups of chicken broth
1/3 cup of tomato sauce

Melt butter. Add flour and baking powder. Mix well. Add egg. Beat well after each addition. Blend in cheese. Heat broth and tomato sauce to boiling. Drop mixture into the hot broth by 1/2 teaspoon at a time. Cover lightly. Cook for 10 minutes.

MUSSELS

mussels
flour
garlic sauce or Hallandaise sauce
olive oil
salt and pepper

Scrub the mussels thoroughly. Wash in clear water. Place in a deep kettle without water and cover. Cook over high heat until the shells open (four to five minutes). Remove the meat from the shells, and roll in flour which has been seasoned with salt and pepper. Fry in olive oil until golden brown. Drain on absorbent paper and serve at once, with garlic or Hallandaise sauce.

CHITON SOUP

2 qts. washed chitons
1 cup water
2 Tb. butter
1 onion
chopped parsley
salt and pepper to taste
1 potato
1 carrot
1 garlic clove
1/4 cup celery
1/2 cup white wine
buttered toast rounds

Put washed chitons into a kettle with water and steam covered for 10 minutes after the water starts boiling. Strain and save the broth. When the chitons are cool enough to handle, remove the meat and discard the shells.

Melt butter in a heavy frying pan or kettle. Add chiton meat, onion, potato, carrot, garlic clove, celery, all finely chopped, cover and saute until the onion is transparent but not browned. Combine enough water with the chiton broth to make 1 quart and add to the vegetables. Season with salt and freshly ground black pepper. Simmer 30 minutes, then add wine. Dish into bowls, sprinkle with chopped parsley and float a round of buttered toast on each serving.

SQUID SAILOR STYLE

4 squid
3 medium-sized onions
1 garlic clove
1 tsp. parsley
2 Tb. olive oil
1/2 cup dry bread crumbs
1 egg
1/2 cup sliced or chopped tomatoes
salt and pepper to taste

Wash squid and remove head and tentacles, reserving tentacles but do not cut body of fish open lengthwise. Boil for 1/2 hour in salted water. Chop onion, tentacles, garlic and parsley fine and saute in olive oil. Add this mixture to dry bread crumbs. Then add the egg and mix well. When fish are cooked, stuff with breadcrumb mixture. Simmer tomatoes for five minutes in a saucepan. Place stuffed squid in baking pan with a little olive oil in the bottom. Cover with cooked tomatoes and bake for about 15 minutes. Serves four.

WAKAME, CUCUMBER, AND RADISH SALAD

1/2 ounce dried wakame
1 1/2-2 ounces white radish, grated
2 ounces cooked fish flakes (leftovers can be used)
1 cucumber, peeled and cut into thin strips

Place the wakame for 10 minutes in enough cold water to cover. Do not soak! Drain. Cut into bite-sized pieces. Prepare the dressing. Place the fish flakes, grated radish, sea vegetable pieces, and cucumber strips in a bowl. Mix the dressing well and pour it over the salad. Toss gently, Serve. Makes 2 to 4 servings.
Dressing: 1 tablespoon honey
2 tablespoons rice vinegar
1 teaspoon soy sauce

KANTEN SALAD

4 ounces of strand kanten
1 tablespoon dashi powder
1 teaspoon sesame oil
1 tablespoon rice vinegar
1 teaspoon honey
2 scallions cut in 2-inch-long slivers
2 carrots cut in 2-inch-long slivers
1 cucumber, peeled, seeded, and cut in 2-inch-long slivers
2 tablespoons toasted sesame seeds

Soak kanten in cold water for 2 minutes. Drain. Wash in cold water. Drain again. Combine dashi powder, sesame oil, vinegar, and honey. Toss with vegetables and sprinkle with sesame seeds. Serve at room temperature or serve chilled.

LIME AGAR DESSERT

1 stick kanten (1/2 ounce)
1 1/2 cups water
3/4 cup freshly squeezed lime juice
1 1/2 cups honey
2 egg whites
1 cup whipping cream

Wash the kanten and squeeze out the water. Place in pan with 1 1/2 cups cold water and soak for 30 minutes. Cook over medium heat until kanten has dissolved completely. Strain through muslin (optional). Cook until liquid is reduced by half. Remove any film as it rises. Remove heat and allow to cool until it is just warm. Add lime juice and honey. Mix well. Beat the egg whites until they form stiff peaks.

Fold the egg whites into the warm kanten liquid. Pour into low rectangular dish that has just been dipped in cold water. Allow to set. Cover tightly and refrigerate. When ready to serve, cut into 1/2 inch squares. Pile into dessert glasses. Top with whipped cream. Six servings.

SHIMMERY APPLE CIDER GEL

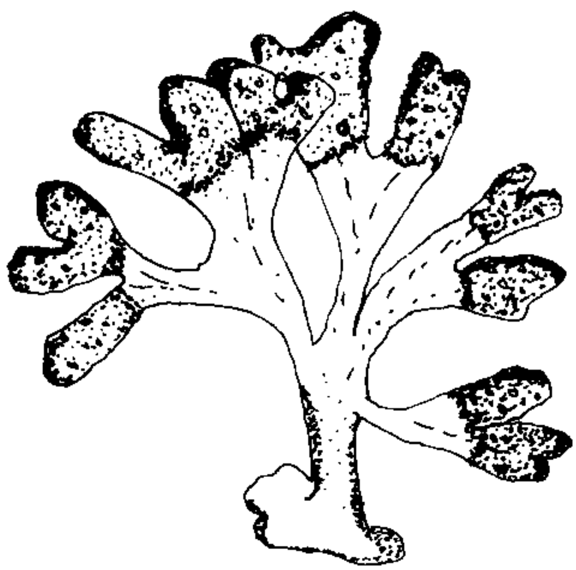
2 cups apple cider
1 1/2 teaspoons agar powder

Makes 4 to 6 servings. Agar, unlike other gels, will set at room temperature, so sweetened desserts will keep without refrigeration.

Boil the apple cider. Remove from heat. Dissolve the agar powder in the hot liquid. Let cool for 5 minutes. Pour into a low flat dish that has just been dipped into cold water. The gel will set at room temperature but should be chilled before serving. Cut the gel into small squares and pile into dessert glasses. Top with whipped cream if desired.

HOT DULSE LEMONADE

1 serving. Soak dulse for 20 minutes in enough cold water to cover. Wash well. Drain. Mix lemon juice and honey in a tall glass. Boil the handful of dulse in the water for 20 minutes. Pour this liquid through a fine sieve to remove the dulse. Fill the glass with the strained liquid. Drink while hot.



DULSE MISO SOUP

1/4 cup dried dulse
1 cup parsnips or
  1 cup carrots, diced
1 quart water
1 teaspoon miso

These light and low-calorie ingredients produce a very rich-tasting soup.

Chop the dried dulse coarsely. Boil the carrots or parsnips in the water until tender. Add the chopped dulse. Boil 10 minutes. Remove from heat. Add the miso. Serve. Servings for four.

SOUP WITH SLIVERED KOMBU

1 quart water
1 tablespoon dehydrated vegetable powder
1/2 cup slivered kombu (Alaria)

Dried slivered kombu is available commercially as kizami kombu. Alaria foraged and sold commercially in North America is often labeled wakame. This is a very basic soup to which a number of foods, especially leftover fish, might be added.

Place water, vegetable powder, and slivered Alaria in a saucepan. Cover and simmer for about 2 hours or until sea vegetable is tender. Serve. Makes 4 servings.

YOGURT DRINK

1/4 teaspoon powdered kelp
1 tablespoon dried dulse, chopped fine
1 tablespoon dried laver, chopped fine
1/2 cup yogurt
1/2 cup tomato/vegetable juice

Place all ingredients in a blender and liquefy for about 1 minute. Serve chilled or place the blended liquid in the top of a double boiler and heat. Serve hot. 1 serving.

FRIED SWEET KELP CHIPS

16 cups fresh kelp fronds

Dried Laminaria may be fried in oil as is, without soaking in water. Just cut the large fronds into squares or rectangles of about 1 inch by 2 inches and fry in peanut oil, a few at a time. Remove to an absorbent paper towel. Sprinkle with raw sugar. Serve.

EUROPEAN APRICOT CANDY

2 cups pureed apricots
3 cups honey
4 teaspoons agar powder
1/4 cup butter
3.5 cup cornstarch

Yields about 2 1/2 pounds.
Dried apricots can be used. Just soak overnight in warm water to cover, then puree the fruit with its soaking water. Heat the pureed apricots, honey, and agar powder together in a heavy skillet. Boil carefully untill the mixture registers 225 degrees on a candy thermometer. Add butter and cornstarch. Pour onto a shallow wooden frame or into a low pan or dish. Allow the mixture to coagulate. Cut into squares.

The following are also sources of recipes:

Texas Parks & Wildlife Magazines

Smoking Fish
Vol. 31, No. 5 (May 1973) p. 19

Lining Up a Dinner (Crab)
Vol. 31, No. 7 (July 1973) pp. 26-29

Midnight Madness (Shark)
Vol. 31, No. 7 (July 1973) pp. 12-16

Let Seafood Solve Your Mealtime Problems
Vol. 34, No. 7 (July 1976) p. 16-19

Young Naturalist: Coquinas (Coquinas Chowder Recipe)
Vol. 34, No. 8 (Aug. 1976) pp. 28-31

The Seavegetable Book by Judith Cooper
Clarkson N. Potter, Inc./Publishers, New York 1977
(Very thorough description of seaweeds and recipes) excellent

The Cooking of Japan by R. Steinberg, Time-Life Books, New York, 1969

The Beach Comber's Handbook of Seafood Cookery by H. Zachary
John F. Blair. Winston-Salem, North Carolina, 1972

ENJOY!

4. The purpose of the living marine resource survey is to determine the living marine resources available in the community and to become aware of them.

   (1) Have the students survey supermarkets, import stores, health food stores, restaurants, and others which you may determine. Have students check with manager, or whoever is in charge, before they begin their survey.

He might provide additional help. Also, in the supermarket survey you may want to divide it up into frozen foods, canned and packages goods.

(2) Or visit a large supermarket, a health food store and then eat at a seafood restaurant as part of a field trip. The manager could provide the group with information and then answer their questions.

5. The answers to "Fishing Laws and Regulations" simulation after one year are:

#1 Millions of fish
20 (Population size at start)
-0 (No fishing)
20
+10 (50% reproduction rate)
30 (population size after one year)

#2 Millions of fish
20(Population size at start)
-5(25% removed by fishing)
15.0
+7.5(50%reproduction rate)
22.5 (Population size after one year)

#3 Millions of fish
20 (Population size at start)
-10(50% reproduction rate)
10
+10 (50% reproduction rate)
20 (Population size after one year)

6. Encourage the students to generate related questions and then answer them. Also, to do additional reading and research.

7. Additional articles on living marine resources:
<u>Texas Parks and Wildlife</u> Magazine

Freezing Seafood
Vol. 33, No. 4 (April 1975) pp. 24-26
Consumers Try Shark Meat
Vol. 34, No. 9 (Sept. 1976) pp. 12-14
<u>Fish and Fishing</u>
Sail!
Vol. 30. No. 7 (July 1972) p. 2-5

Deep-sea Snappers
  Vol. 30, No. 11 (Nov. 1972) pp. 6-9
Fishing the Jetties
  Vol. 31. No. 5 (May 1973) pp. 2-5
Under the Lights (Party Boat)
  Vol. 31, No 6 (June 1973) pp. 2-5
Midnight Madness (Sharkfishing)
  Vol. 31, No. 7 (July 1973) pp. 12-16
Drag Up a Drum
  Vol. 32, No. 2 (Feb. 1974) pp. 2-5
Tug-of-War with a Jewfish
  Vol. 32, No. 12 (Dec. 1974) pp. 18-20
Above the Surf
  Vol. 34, No. 2 (Feb. 1976) pp. 2-5
Peir Fishing at the Tip of Texas
  Vol. 34, No. 4 (April 1976) pp. 22-25
Learn about Redfish
  Vol. 34, No. 6 (June 1976) pp. 24-26
Don't Over Look the Sand Sea Trout
  Vol. 34, No. 8 (August 1976) pp. 10-11
Black Drum
  Vol. 35, No. 2 (Feb. 1977) pp. 19-21
A Favorite with Coastal Fisherman
  Vol. 35, No. 3 (March 1977) pp. 20-22
Fish Follow the Shrimpers
  Vol. 35, No. 6 (June 1977) pp. 2-3
Fishing the Underwater Cities
  Vol. 35, No. 7 (July 1977) pp. 10-11
Hide-and-Seek Fish
  Vol. 35, No. 8 (August 1977) pp. 13-15
Winter Fishing
  Vol. 36, No 1 (Jan. 1978) pp. 14-15
Fishing Sea Rim
  Vol. 36, No. 2 (Feb. 1978) pp. 6-9

Management, Research, Problems and etc.
Biological Overfishing
  Vol. 31, No. 6 (June 1973) pp. 16-18
Fish Graveyard
  Vol. 31, No. 7 (July 1973) pp. 16-17
Hatchery Redfish
  Vol. 31, No. 9 (Sept. 1975) pp. 24-26
Coastal Creel Survey
  Vol. 33, No. 6 (June 1975) pp. 22-23
Mariculture
  Vol. 33, No. 9 (Sept. 1975) pp. 12-14
Gulf Shrimp Patrol (pp. 14-15) and A Coastal Mystery (pp. 18-20)
  Vol. 34, No. 10 (Oct. 1976)

Tracking Shrimp
Vol. 36, No. 7 (July 1978) pp. 22-23

National Geographic Magazine
Giant Kelp, Sequoias of the Sea
Vol. 142, No. 2 (Aug. 1972) pp. 251-269
Life Springs From Death in Truk Lagoon (pp. 578-603)
and From Graveyard to Garden (pp. 604-613)
Vol. 149, No. 5 (May 1976)
Where Would We Be Without Algae?
Vol. 145, No. 3 (March 1974) pp. 361-377

A SEA FOOD CONNOISSEUR?

LESSON TWELVE

ACTIVITY ONE

Complete -

Are You a Sea Food Connoisseur? activity.

Share -

Ratings with your classmates.

<u>Optional</u>
Conduct -

A survey to determine how others in your community feel about sea food by using <u>Are You a Sea Food Connoisseur?</u> form.

Read -

A Diner's Delight??

Answer -

The questions.

Taste -

The sea foods in the Seafood Fair.

Complete -

The Sea Food Fair Taster Report.

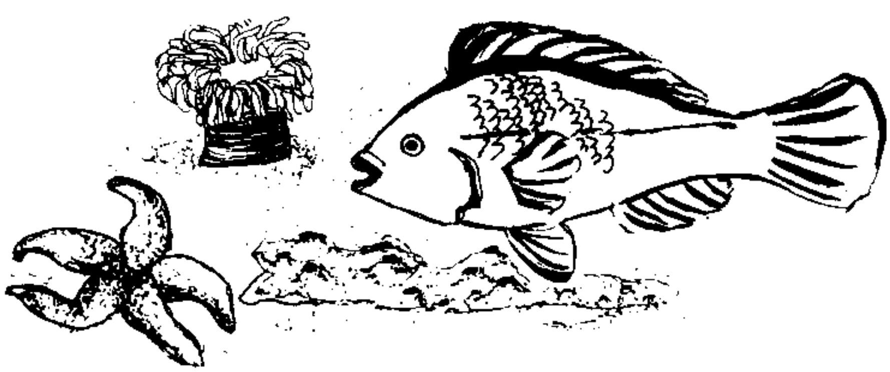
Share -

Your report with your classmates.

ARE YOU A SEA FOOD CONNOISSEUR ?

Place your intials on the line that represents your position.

	Would Never Eat It				Would Eat It If Tasted Good
	1	2	3	4	5
Clams					
Green Algae					
Crabs					
Conch Shell					
Eels					
Flounder					
Kelp					
Octopus					
Ocean Perch					
Oysters					
Red Fish					
Sea Cucumber					
Sea Trout					
Sea Urchin					
Scallop					
Shark					
Shrimp					
Squid					
Turtle					
Whale					



For how many marine organisms did you put your initials in the far right column or #5?________________________________

If you said sixteen or more, you are on your way to becoming a sea food connoisseur. Congratulations!

How many of the marine organisms have you actually eaten?

____

If you said between 6 and 9, then you are just average on the world standards.

For how many marine organisms did you put your initials in the far left column (#1)--you would never eat? __________

Why would you never eat some marine organisms? __________

____

Would you consider tasting them? ____Why or why not?

____

____

A DINER'S DELIGHT??

The Menu

Appetizer: Makinori (Japanese seaweed)

Soup: Turtle and Algae soup

Entrees: Sea squirts, sea urchins, sea cucumbers, octopus, eel, oysters, clams, mussels, abalone steak, or other fish or shellfish

Desert: European apricot candy, peanut mousse

Drink: Bladderwrack tea

This menu would delight diners in Japan, China, the Carribean, the Mediterranean and even France and Mexico. The Japanese, for example, eat nine sea mammals, sixty-three species of fish, eight varieities of shellfish, three kinds of clams, and two of shrimp. Each home also has seafood each day so there is no such thing as a Japanese seafood restuarant.

Even though great numbers of these marine organisms live off the coasts of the United States, they are not eaten. There may be more to eating seaweeds and sea urchins than a dietary treat. There is a relationship between the fish diet and low heart disease. So maybe we overweight Americans who favor meat and potatoes over fish may improve our health as well as adding variety to our life by eating foods from the sea.

1. How would you explain the differences between the way you think of marine organisms and the way the Japanese and others use marine organisms as food?

2. Why is food from the sea a part of every meal for some people like the Japanese?

3. Could you live in Japan with a family and eat their meals? Woud you do it?

4. What effect do you think advertisement would have on people to eat a greater variety of marine organisms like the Japanese?

SEA FOOD FAIR TASTER REPORT

Put an X on the point on the line that represents your feelings about a food item.

Try to guess the main ingredients (sea foods) in each of the foods that you have just eaten. List them in the column on the right.

Number of the Food Item	Disliked the Taste	Liked the Taste	Ingredients

1. How many items did you like?

2. How many items did you dislike?

3. For how many dishes did you get the ingredients correct?

4. Did any of the ingredients surprise you? If so which ones?

5. What changes in your ideas about food from the sea have taken place as a result of the seafood fair?

6. Which dishes of ingredients do you think could become an important part of food production and nutrition in the future?

FOOD FROM THE SEA

LESSON TWELVE

ACTIVITY TWO

Read -

It's Good For You!
FPC.
Fish as Animal Feed.

Answer -

Questions.

List -

Several steps you would suggest taking to increase the use of marine algae and organisms like the sea urchin in the United States.

Conduct -

One of the surveys to determine the living marine resources available in your community.

Share -

The results of your survey with your class.

ITS GOOD FOR YOU!

MEMORANDUM

To: Captain Seaborne

From: Sally Seaweed, Nutritionist

Subject: Response to your request on nutritional value of seafoods.

Today as we learn more about nutrition, we know that seafoods are excellent foods and often better than food from the land. For example, protein from most fish contain fewer calories and less fats and oils than the majority of meats. Many sea vegetables (algae) contain fats and oils, yet they are very low in calories and cholesterol. Seafoods contain adequate amounts of the essential amino acids (parts of protein). Also we can digest 90-95% of fish protein but only 87-90% of the beef protein. Sea vegetables (algae) have more proteins than rice or soybeans.

Seafoods are rich in the minerals and trace elements we need. Since our blood contains all of the elements found in sea water, there is no better way of providing the body with all the trace elements than by eating sea vegetables (algae) and seafood. Oysters and other shellfish and sea vegetables are an excellent source of iodine. A lack of iodine causes goiter. Fish are a source of fluorine, important in preventing tooth decay.

The sea vegetables are rich in A, B, B_{12}, C, D, E, Niacin and others. Some algae are richer in vitamins than the richest animal source. Some green algae contain more vitamin B_{12} than liver. Some algae have more vitamin C than lemons and more vitamin A than chicken eggs. The oils from sea vegetables contain a thousand times more vitamins A & D than cod liver oil.

The research into nutrition and preventive medicine in relation to food from the sea is new. Studies have already shown that a diet high in fish results in fewer heart attacks in middle-aged men. High fish diets also seem to reduce obesity and high blood pressure. Therefore, more findings are sure to come. Captain Seaborne, I am already convinced that food from the sea is good for us.

F P C

Fish protein concentrate (FPC) is an excellent source of high quality, low cost animal protein. It is made by processing the whole bodies of "trash fish". These fish such as hake, sea robins, skates and others are not accepted as food by man. This is either because of traditional preferences or because of their small size which makes processing them expensive.

FPC is odorless and can be stored indefinitely. It does not change the taste or character of food. It can be used in foods to improve the quality and increase the quantity of protein and minerals without increasing fat content. A mixture of nine parts of wheat flour and one part of FPC is three or four times more nutritious than just wheat flour alone. This flour can be used to prepare foods such as bread, cakes and cookies.

FPC can be used to fortify many of the cereal products, like bread, pasta (macaroni products), crackers, cookies and sauces. This could help increase the world's available protein. At the same time it makes very efficient use of a catch of fish by using all parts.

FISH AS ANIMAL FEED

Currently in the United States, each person eats an average of 11 to 12 pounds of fish per year. The largest portion eaten is frozen breaded fish. However, the largest volume of fish is eaten indirectly. More than 55% of the fish caught by U.S. fishermen becomes poultry and livestock feed.

Since fish meal is high in nutritional value, it is part of the diet for young chickens and turkeys. As a result, chickens and turkeys use about 85% of the fish meal available in the United States. Five to ten percent of the fish meals is used for pigs.

Fishery products are the essential raw materials for the pet industry. Canned cat foods contain from 25%-100% fish. Pet birds are also fed fish-based feeds. These are usually made from crab and shrimp wastes.

Since fish have high protein and low fat levels, they are the main ingredient in feeding fur-bearing animals, especially mink. Fish make up 40-70% of the food for these animals. Yes, over half our fish catch goes to feed other animals.

1. If you are trying to lose weight why would food from the sea be good to eat?

2. Discuss the statement "Food from the sea is the world's insurance against starvation."

3. Why do you think that we aren't eating or gathering sea vegetables to sell in our grocery stores along with the other vegetables?

Supermarket Survey

You will be looking at several sections of the grocery store for products from the sea. Divide your paper into 3 columns. In the first column list the item. In the second column list the marine organism(s) which is/are the ingredients. In the third column list the weight and the price of the item. In your survey check the fresh foods, frozen foods, canned goods, imported or speciality foods.

Check with the manager and see if you can learn:

1. Which seafood items were the most popular?
2. How do they obtain their sea food?
3. What determines whether an item is added or removed from the store's stock?
4. What is the price per pound of fish, shrimp, steak, roast, chicken, and pork chops? Which is cheapest? Which is the most expensive?
5. In which section did you find more food from the sea: fresh, frozen, canned goods or etc.? How many items did you find in each section? Was the number of items more or less than you expected?

Restaurant Survey

Divide your paper into 4 columns. In the first column list the items on the menu which contain sea foods. In the second column list the marine organism(s) which is/are the ingredients. (If the menu only states that it is broiled fish, see if you can learn what kind of fish is used.) In the third column list the price of the item. Since the price will depend on amount, preparation time and ingredients in column four rate the marine organisms as to cost. 1--most expensive and etc. The manager may or may not be able to tell you this.

Question:

1. Which seafood items were the most popular? Why was this most popular?

2. How does the restaurant obtain its seafood?

3. What determines whether an item is added to or removed from the menu?

4. How does the seafood compare in price to non-seafood items?

Health Food Store or Oriental Food Store Survey

Divide your paper into 4 columns. In the first column list the item. In the second column list the marine organism(s) which is/are the main ingredients. In the third column list the amount and cost of the item. In the fourth column list some uses of of the item.

Ask the someone to help you if possible, since you may not know if the item is from the sea or not by its name.

Questions:

1. Which seafood items are the most popular? Why is it the most popular?

2. From where and how do they obtain the items?

3. What determines whether an item is added or removed from the store stock?

4. What were the most unusual items you found?

5. Who are the people that buy the seafoods here? What will they be using them for?

WHERE WOULD WE BE WITHOUT THE ALGAE?

LESSON TWELVE

ACTIVITY THREE

Read -

Those All Important Seaweeds!!

Determine -

Which products in your home contain algae gels-
Read the Labels activity.

Answer -

The questions.

THOSE ALL IMPORTANT SEAWEEDS!!

The marine algae or sea vegetables are not just a source of food for man and animals. In fact I'll bet that you cannot get through a day without coming in contact with something made from a seaweed colloid or gelling compound.

Sea vegetable gels (algin, alginate, carrageenin, agar and gelation) are found in our kitchens. We eat these algal gels, completely unaware that they are in our prepared foods. Some of these are yogurt, chocolate milk, ice cream, marshmallows, candies, bread, coatings for canned meats and fish and even more.

Historical records show that the use of seaweeds in agriculture is very old and widespread wherever there are rich supplies. They are used not only for food but also as a fertilizer for the soil. Cattle, poultry and pig feeds are produced from dried seaweeds by grinding them into a meal. This is mixed with ordinary food to give a balanced diet, since the seaweeds contain minerals and trace elements.

In recent years a liquid extract of seaweeds that is high in nitrogen and potash but low in phosphorous has appeared. This seems to increase resistance of the crop to abnormal temperatures, aphids attacks and fungus diseases. It even helps plants take nutrients from the soil. There is some indication that cows fed on grass fertilized by seaweed fertilizer are healthier.

Seaweeds are also important in industry. Some of these uses are in the brewing of alcoholic beverages, cosmetics and shampoos. Also in the making of linoleum, artificial leathers and silks, insulation, water-base paints, ceramics. They are important in paper products for packaging of milk, butter, frozen food, and the adhesives in paper bags, gummed tape and decals. In medicine they are used in blood anticoagulants and as a culture media. Another potential use of the algae is in the maintenance of life in space crafts. These are a few examples. To list them all would take several pages. It seems the uses are only limited for lack of the right seaweed, or our knowledge. But even more important, perhaps as much as 90 percent of all photosynthesis is accomplished by algae. And in the sea, as the vegetable part of plankton, they are the food upon which all life depends.

READ THE LABELS

Let's see how many products in our home have sea vegetable (algae) gels in them. Read the labels to determine the ingredients in a product. If the product lists: algin, alginate, carrageenin, agar or gelatin as an ingredient then it contains an algae gel.

Divide your paper into three columns. In the first column list the item which contained the algae gel. In the second column in what room or your house the item was located and in column three place a check mark if you have used the item.

A Reminder--Check all labeled products--pharmaceutical, all dairy products, beverages, bakery, candies, dressings, sauces, dietetic foods, meat & fish products (sausages & canned products), soups, baby food, jams, cosmetics and paints.

1. How many products in your home contain algae gels? How many of these do you use?

2. What effect could thermal pollution and toxic chemicals from industry have on the algae and products that use algae gels?

3. Along the east coast and the west coast the algae are numerous. However, as we round the Gulf shore from Florida toward Louisiana we find the Mississippi river and other rivers have had a stunting effect. Algae are found mainly on the wharfs, pilings and jetties. Can you explain this?

4. What would be the advantage of using gelatin made from algae instead of animal gels made from hoofs and cartilage of animals?

FISHING

LESSON TWELVE

ACTIVITY FOUR

Read -

Fishing in the Past.
Fishing-Today.
The Texas Fisheries.
Where Have All the Fish Gone?

Set up-

Model fish populations in the Fishing Laws and Regulations activity to determine how different fishing regulations affect the size of fish populations.

Answer -

The questions.

Optional
Read -

Article in Texas Parks & Wildlife on fishing or fish.

Optional
Report -

On the article your read to your classmates.

Write -

A short story on a day in the life of a fisherman.
Select one of the following fisherman:
Oyster
Shrimp
Tuna
Game
Deep Sea
Factory Ship
Lobster
And others

FISHING AND THE PAST

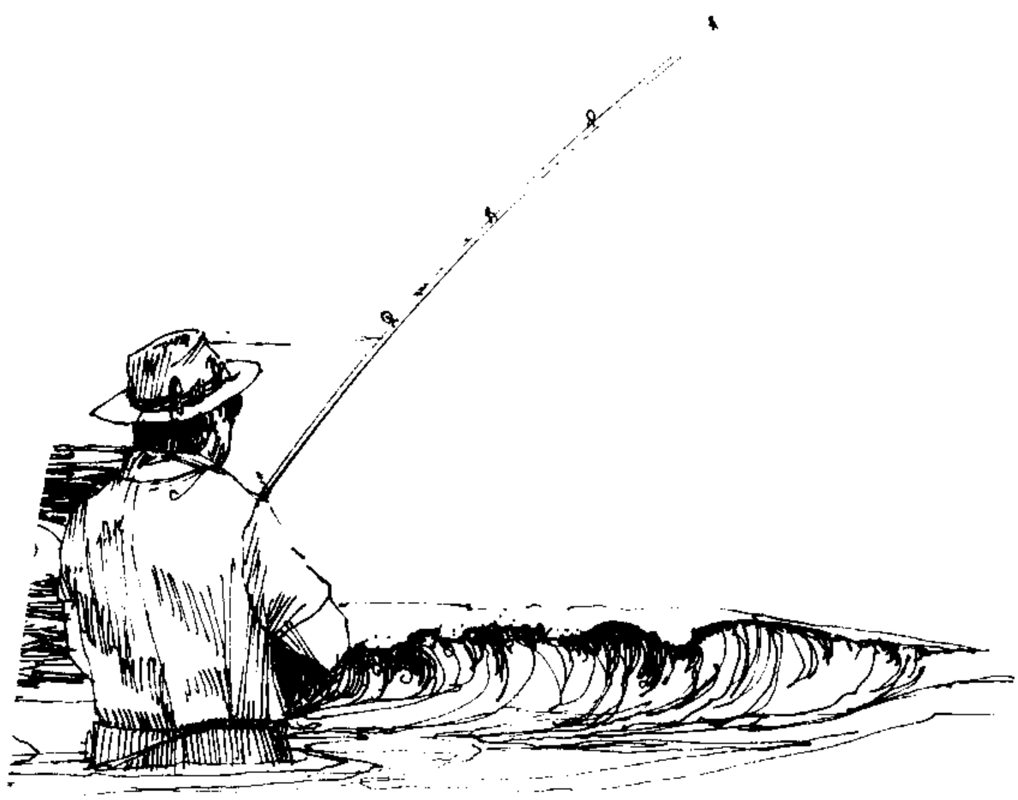
Early man began to fish about 10,000 years ago. He fished like other land animals. He would grab his prey out of the water with his hands. Clams and oysters were probably the first seafood man ate. Then hooks and nets and other simple tools were invented.

The Karankawa Indians of the Texas Gulf coast collected oysters, clams and other shellfish with their hands. They also used the bow and arrow and boats. The early Texas settlers used hooks, lines, nets and boats. With these simple methods, man did not wipe out his food supply by overfishing.

Early man had a knowledge of marine life-cycles and marine behaviors. None of the tools he used are of any value without an understanding of where and when the fish will be.

These early fishermen could not have seriously overfished an area. Yet, they know that overfishing could affect their food supply and had to be avoided. They discovered the first laws of ecology. They wove these into their religious beliefs. To disobey these laws was to risk the anger of the sea gods. Fish were not taken during spawning season, a number of young had to be tossed back, and no more fish could be taken than could be eaten.

However, with the advance of technology, beginning with the harpoon gun, this began to change. Modern fishing equipment and ways have led to the loss of the old ways and traditions which respected the creatures of the sea.



FISHING-- TODAY

Today the living animal resources of the oceans are being hunted by a variety of vessels. They vary in size and complexity. They range from a South Sea island dugant to a Russian factory ship over 700 feet long. The design of the fishing vessel is determined by the species of fish it will catch.

In the past, locating fish was difficult and an experienced captain was probably the best asset a boat could have. Today electronics and space technology are used to find fish. Echo-sounding is used to locate schools of fish. Sensitive cameras on high-flying planes and satellites are used to record the disturbance of bioluminescent plankton caused by schooling fish. Ultrasensitive microphones are used to pick up the locations of fish.

The Russian fishing fleet operates like a naval operation. Administrators direct fishing activities in each of the major seas like commanders moving their forces in battles. As many as 300 ships will travel in a group accompanied by factory ships and transport vessels.

The factory ship begins processing the catch as soon as it is taken on board from other vessels. One such factory ship, which is 540 feet long, is able to salt 200 tons of herring; process 150 tons of fish into meal; filet and freeze 100 tons of bottom fish and manufacture 5 tons of fish oil, 20 tons of ice and 100 tons of distilled water all in one day. The Russian government pays for the fleet which puts other fishing nations and the fish at a disadvantage.

THE TEXAS FISHERIES

The Texas coastline has a total estuarine and coastal lagoon area of 2100 square miles. This area is the major spawning ground and nursery for 70% of the fish population of the Gulf of Mexico. Shrimp also during their early life, live in these large fertile areas until they are large enough to enter the Gulf of Mexico.

Fishermen from many states and several countries earn their living shrimping the productive Texas bays and nearby Gulf. Shrimp is the most valuable fish product in the United States, with Texas and Louisiana being the top two shrimp producing states.

Shrimp, oysters, fish and crabs are part of the Texas fish catch. Shrimp, however, make up about 90% of the states' commercial catch. Shellfish (shrimp, oysters, crabs, and squid) totaled over 83 million pounds with a value of over $113 million in year of 1975-76. Fish taken commercially totaled over 8 million pounds with a value of $2.8 million. The commercial fish production on the Texas coast could be increased several times above the present level without serious effect on the supply.

Although Texas has one of the largest fishing industries of any state in the United States, it is still small compared to other industries. The seafood industry is very important to the coastal economy. It produces millions of dollars in income and employs over 15,000 people.

Problems do exist. The production of shrimp and the Gulf fish depends on the conditions of the bays and estuaries. Therefore, both pollution and changes in the estuarine environment such as dredging and filling can have bad effects on production.

Every year the Texas shrimping industry catches an estimated 500 million pounds of fish. Many of these fish are small and presently worthless. The development of fish protein concentrate, fish meal, and possibly fish sausages may be ways to use these fish. Research and development of the use of these waste fish is needed. Much can be done to improve the Texas fisheries.

WHERE HAVE ALL THE FISH GONE?

Early man began to fish almost 10,000 years ago, but the technological and attitude changes now threaten the survival of some of the living resources of the sea.

In the 100 years from 1850 to 1950 the world fish catch increased 10 times or 25% every 10 years. However, in the 10 years from 1950 to 1960, it doubled. It doubled again from 1960 to 1970.

However, since 1970 there has been no great increase. Overfishing has taken its toll. At least twenty species of fish are close to being or have been overfished. These include tuna, herring, cod, ocean perch, haddock, anchovy and others. In fact, by the 1980's there may be no healthy fish supplies left.

An example of what is happening occurred in 1965. The large Russian fleets moved into the northeast coast of the United States and took tremendous amounts of haddock. This fish is of value to American and Canadian fishermen. The International Commission for Northwest Atlantic Fisheries attempted to regulate the haddock catch. However, the Russians disregarded this. By the end of 1967, the Russians had almost wiped the fish out. It is estimated that the 1963 catch of haddock alone could have supported the U.S. and Canadians for 10 years.

It has been charged that the Japanese have been seriously irresponsible. They have shown little interest in conservation. Their research seems to lie only in developing and expanding the catches.

In North America and Europe, conservationists are asking: "Can the oceans support massive fish takes? What is the morality that urges us to take as many fish as we can---because if we don't the Russians or Japanese will?"

Only quick and close cooperation between all nations can prevent the destruction of the fishery resources of the world.

FISHING LAWS AND REGULATIONS

Fishing laws and regulations are designed to maintain healthy fish populations while giving everyone an equal chance to enjoy the sport of fishing or work as a commercial fisherman. Let's determine how different fishing regulations affect the size of fish populations.

Set up a model fish population. Use beans or other small objects to represent fish. Each object will represent 1 million fish. The model will have 20 million fish and we will change the regulations to see what happens to the populations. Each population will have the same yearly natural reproductive rate. The number of young born will be 50% of the number of fish in the population. We will simulate fishing by removing fish (beans) from the population. We will add fish (beans) to the population to simulate natural reproduction. (Note: In this model, we will not consider the effects of starvation, disease and etc. You may want to add a % for death and disease each year.) Carry out each simulation below for four years.

1. The regulations are that there is no fishing.

2. The regulations will permit 25% of the fish to be removed by fishing each year.

3. The regulations permit 50% of the fish to be removed each year.

4. Set your own regulations.

Questions:

1. Did any of the populations increase in size? decrease in size? remain about the same?

2. If you were a fishery biologist, which set of regulations would be best to:
   A. Keep the size of a fish population about the same.
   B. Decrease the size of a fish population.
   C. Increase the size of a fish population.
   D. Allow the optimum catch over a long period of years?

3. If you were a fishery biologist and wanted to increase the size of a fish population but also wanted to allow people to enjoy fishing, which set of regulations would you use?

4. What would happen if regulations did not allow any fishing and the fish population size increased beyond the limits of the fishes' habitat?

5. What would happen to a fish population if fishing were not regulated; that is, if people could catch fish by any method (netting, trapping, and etc.) and could catch as many as they wanted?

6. Discuss laws and regulations as importants management tools.

7. What effects do politics, emotions, and other factors have on fishing?

THE FUTURE

LESSON TWELVE

ACTIVITY FIVE

Read -

Housing Shortage.
A Blue Revolution?
The Future-Scenario A.
The Future-Scenario B.

Answer -

Questions.

Find -

Articles and pictures in magazines and newspapers which portray some of the issues concerning living marine resources.

Make -

A collage illustrating some of the issues with pictures, words, slogans and etc. Draw your own or cut them out of a magazine or newspaper.

Write -

A short scenario of what you think or hope the future of living marine resources will be.

List -

Some of the steps which must be taken to make your future scenario become reality.

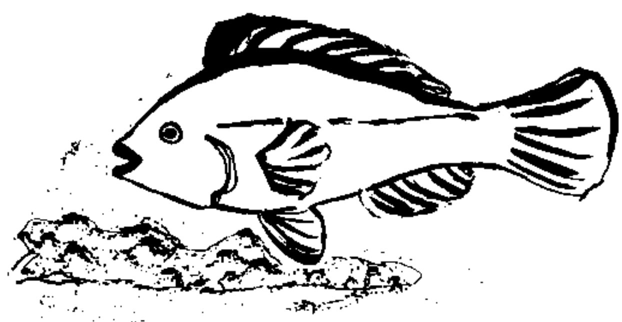
Make -

Buttons to express your views on living marine resources (seafood, algae, fish, fishing and etc.)

Housing Shortage

The largest part of the ocean is covered by mud. So there is a housing shortage in the ocean. A large number of marine organisms need a solid surface for attachment. The more surface, the more organisms. Also many marine organisms need areas in which to hide from their predators.

Divers have often noticed that fish collect around wrecked ships and the offshore drilling platforms. This had led to building of artificial reefs in the Texas coastal area to increase fishing. These reefs are composed either of oyster shells placed in bays to form oyster reefs or of old car bodies, concrete blocks, pipes or other structures including old ships. The 3000 or more oil platforms built off Louisiana and Texas coast provide a similiar artificial reef. Well-organized artificial reefs have become and could become a simple way to farm the thinly populated areas of the oceans.



A BLUE REVOLUTION?

There are more than two million acres of under-used lowlands along the Gulf coast. They rent for as little as $3 per acre or sell for $300. Someday they may be covered with neats rows of rectangular man-made ponds. They will be fed by water pumped from the bays and filled with shrimp. A dream? No, a possibility. In 1969 a team of researchers began a shrimp mariculture program at Flour Bluff near Corpus Christi. This program will answer the questions of shrimp culture. It will develop the procedures and technology for shrimp mariculture.

Mariculture is the raising of marine organisms under contolled conditions. The Chinese, 2,500 years ago, grew oysters and fish. It was the first recorded mariculture operation. Freshwater fish have been raised in hatcheries for 2000 years, but this is not the case of saltwater fish. The problems are greater for saltwater fish since proper salt water balances and temperature must be maintained. Also, we do not know all the answers to questions about diseases, parasites and reproductive cycles. Today the following organisms are part of mariculture programs: the finfish--salmon, perch, yellowtail pompano, top minnow and mullet; shrimp, crabs, lobsters, oysters, clams, mussels and algae.

The potential is tremendous. If the technological changes are properly used, a Blue Revolution can result. This would be the development of a new food supply to help stop world hunger. At present, the government backs the research for lobsters, shrimp and other luxury sea foods instead of the fish that are easier to raise and not as popular.
The luxury seafoods of lobster and shrimp have less protein than the fish. However, sea farming will probably never replace fishing in the way that land farming has replaced hunting. Even if we solved all the problems, the ocean, like the land, can only feed a yet unknown but limited number of people.

THE FUTURE-- SCENARIO A

The sewage from a secondary treatment plant of a coastal city is used to grow plankton algae. These plankton algae remove nutrients from the sewage. Oysters then remove the algae from the water. Some of the nutrients are returned to the water in the form of wastes from the oysters. These nutrients are used by seaweeds especially sea lettuce. The seaweeds are then fed to abalone (mollusks). The oysters' solid wastes which drop to the bottom of the tank are eaten by sandworms. The sandworms are put in another tank to serve as food for the flounder.

The products of this mariculture system are oysters, seaweeds, worms, flounder and abalone. The sea farm also becomes a sewage treatment plant,with clean water being returned to the sea.

In the open Gulf, there is an inexpensive raft,or mesh,40 to 80 feet down from the surface with growing seaweeds attached. Pump intake pipes extend down into the cool, nutrient-rich,water. The nutrient-rich water is brought to the surface by wave or wind powered generators. Harvesting of the seaweed is accomplished by special vessels which move over the frames and cut off the upper part of the seaweeds. These ships remove the water from the seaweeds and then carry them to processing plants on shore.

In the open spaces left in the seaweed fields, nets are lowered and fish from the seaweed fields are lured into them for catching. In other seaweed fields part of the harvest is fed to fish, abalone, snails, and other invertebrates in separate mariculture operations.

The seaweed is also processed by a digestion fermentation process into methane, plus other products such as fertilizers, ethanol, lubricants, waxes, plastics and the complete group of useful petrochemical products.

THE FUTURE-- SCENARIO B

It was a fine morning with a smooth sea, sunny warm weather, and the companionship of friends. The older member our group began to comment. "The pollution has killed everything." He goes on: "You could look down with a mask from the surface and see the wrecks on the bottom." He always compained that "there are no ducks, no fish, nothing. There's nothing out here. They're all dead and those that are alive, I'm afraid to eat."

It wasn't that we doubted his word, but he remembers another time. Most people don't. We take the pollution, turbid water, silt and lack of marine life for granted. We have been brought up with it.

Twenty miles out at an old ship wreck the surface water was fairly turbid, we decided to dive down and take a look. We passed through layers of yellow brown matter. At 100 feet down there was no light. On the wreck, it was completely dark. Fish were lying on the bottom belly up, dead lying everywhere. No diver observed any live fish. Anemone, starfish and mussels were also dead. A black substance covered the sand everywhere.

Commercial fishermen run miles and miles from port to find any fish at all. And they have been pulling up dead fish in their nets. The price of fish is so high that only the wealthy can afford them. Mass starvation and food riots are beginning to occur. Food is more precious than gold.

1. What kind of energy is needed to produce seaweeds?

2. What beneficial side effects does mariculture have on the environment?

3. Why would it be good to feed seaweeds to animals which are grazing on mineral deficient pasture land?

4. How would food shortages affect life in the United States?

5. Why is fishing to feed the world as naive as trying to feed billions by hunting wildlife?

6. Why will mariculture only postpone disater if man does not keep a stable populations level in the future?

7. What problem limits the growth of sea farming?

8. What environmental and legal/political problems can the farming of algae or marine organisms produce?

9. Do you think sea farming will become an important source of food in the future? Why or why not?

10. What evidence in today's world suggests that this forecast in The Future-Scenario B could come true? Can you see any evidence that it would probably not come true?

BUTTONS

People often use buttons to show who they support in elections or where they stand of issues. Let's say that you have decided to tell the world your views on living marine resources (seafood, algae, fish and etc.) by making a whole bunch of buttons. What would they say in words or pictures? Use the space below to sketch your button designs.

1. Number the buttons according to how important they are to you. (1=most important, etc.)
2. Would you wear them everywhere?
3. Is there anywhere you wouldn't want to wear some of them?
4. Are there any you wouldn't wear at all?